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A Survey on Inter and Intra Domain Routing Techniques

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ABSTRACT

The primary objective of this survey is to analyse the various challenges and open issues of Inter domain routing in various fields. The survey paper mainly focuses about Inter and Intra domain routing in a network. This paper surveys several research challenges in Inter and Intra domain routing. These challenges are described in a comprehensible manner. The main aim is to put things into perspective and summarize the concepts. In this survey we have made comparisons on various techniques used in the Inter and Intra domain routing and on how various challenges have been handled and what steps have been taken in order to reduce it.

Keywords: Interdomain routing, congestion, Quality of service(QOS) and Route optimization.

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INTRODUCTION

Routing is the process of moving data packets from source to destination across a network. It is the process of choosing the best path in a network to send the packets. Packets are the fundamental units of data transfer in all networks. Route Optimization is the process of determining the most cost-efficient route. It needs to include all relevant factors such the number and location of all the required stops on the route. Routing is classified into two types. Inter domain routing is the process of routing between different AS. Protocols for inter domain routing are called as exterior gateway protocols with BGP being one of the most popular used protocol. Intra domain routing is the process of routing between different AS. Protocols for intra domain routing are called as interior gateway protocols. An AS is a network or a collection of networks that is controlled by a common network administrator and managed by a single authority. An AS shares routing information with other AS using the BGP protocol. Congestion is a major factor in Inter-Domain routing. It is a situation in which too many packets are present in part of the subnet which degrades the performance. It occurs when the load on the network is greater than the capacity of the network. The main reason behind congestion control is that the routers are slow to perform queuing, buffering and updating table. The router's buffer is very much limited and the processors are slow. QoS is the idea that transmission rates, error rates and other characteristics can be measured and improved for better networking services. QoS can be improved with traffic shaping techniques such as packet prioritization, application classification and queuing of congestion points. Cut-through switching is a method for packet switching systems, where the switch starts forwarding a packet before the whole packet has been received, normally as soon as the destination address is processed.

RELATED WORK

Inter-domain and Intra-domain routing Techniques

The authors Adrian Lara, Shreyasee Mukherjee, Byrav Ramamurthy and et.al (2016) propose mechanisms in order to replace Internet Protocol to support content delivery and mobility. The problem with efficient data transfer is solved by Inter-Domain cut through switching using Software Design Network (SDN). First the optimization problem is solved by minimizing the total transfer time using tunnels and then a SDN based frame work is creating tunnels for mobile first architecture. The tunnels are named as network object which simplifies creating and maintain tunnels[13]. The Software Defined Networking is a key technology to make the Inter- Domain tunnels programmable and more flexible in a controlled network. GENI (Global Environment for Network Innovations) which is a test bed proto type is implemented. With the help of GENI packet in messages can be reduced by 75% using Inter-Domain tunnels. When compared to the current protocols like Label Distribution Protocol (LDP) fewer messages are require in the framework for setting up Inter-domain and Intra-domain. From Figure 1 it is seen that the GNRS (Globally available name resolution service) is used to setup cut- through switching across multiple domains and the number of messages to be exchanged is controlled and reduced with the help of controller domain. The packets request for creation of tunnel when a neighboring domain controller accepts the request, a GNRS entry is created it contains information related to the tunnel. The domain controller known's the GOID of all the entries and information to be collected about the tunnel. The GNRS entry can be used by domain controllers to share the tunnel attributes with other domains such as availability of bandwidth or expected time before having the tunnel to terminate. GNRS reduces complexity of establishing sessions between multiple domains and reduces the number of messages. The main advantage of GNRS is that it is globally available entity. It can be done by cut-through switch tunnels across multiple domain[1].

Algorithm:
Step 1: update Ginter A (i) and IDRM routing table when receiving Beacon according to inter-domain policy
Step 2: update IDRM routing table when receiving Routing table Update according to inter-domain policy
Step 3: if (IDRM routing table changed) then
Step 4: send Routing table Update to Ginter A (i) and Gintra
A (i)
Step 5: end if
Step 6: if (recv data packet) then
Step 7: handleDataPacket (pkt)
Step 8: end if

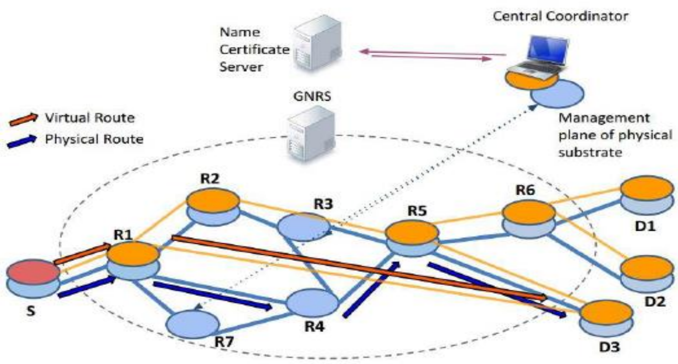

Figure 1 Updation of IDRM routing table

In their titled Reputation for Inter – Domain QoS Routing the authors Emmanuelle Anceaume, Yann Busnel, Paul Lajoie-Mazenc and Géraldine Texier (2015) have mainly worked in regards to Internet Traffic which need to provide end-to-end Quality of Service. There are many challenges which had been faced which required fair and strong co-operation among different network operators or Autonomous System. But having a single autonomous system creates trust issues and does not guarantee end-to-end Quality of Service. But by introducing Reputation Mechanism all the issues regarding QoS can be solved [7]. It estimates how trustworthy and reliable entities are functioning and does not require any help from central authority and it improves the QoS of Inter-Domain routing. The reputation mechanism does rating of each involved entity. These ratings are aggregated and the publicly available reputation scores are computed. The entities having a good reputation score will be the ones providing correct services to others. This makes sure whether the paths are reliable or unreliable paths. There are chances that the non-eligible AS may try to deceive clients and create more traffic and collision. A reputation score gives feedback and opinions from clients during the past experiences and transactions with a provide[10]. The system has entities: Source and Destination end-users. Let the end-users be S and D. Once they used the path it is rated and tested whether the AS has delivered the promise of QOS or not. There are chances of security attacks such as manipulation of ratings and reputation stores. In order to avoid these security properties have been created. Integrating a double mechanism for end users and AS would greatly improve the efficiency of inter domain QoS routing.[2]

Algorithm:

Step 1: A path set-up request from end-user with specific QoS needs is received by an RCMP in the Alliance Network
Step 2: The path-originating RCMP uses network reachability information and MPCE to calculate multiple paths.
Step 3: Each path-vector is expressed in terms of constituent RCMP entities along the path.
Step 4: A *probe message* is sent along each possible path. It carries parametric information for the desired QoS requirements and also has fields for updating QoS path parameters.
Step 5: If an intermediate AS agrees to provide the resources, (typically by accommodating the request in the existing transit LSP tunnel or by setting up new LSP) it updates the path based QoS parameters in the *probe message* and also adds the costs involved. It temporarily reserves the requested resources.
Step 6: In the first round, the *probe messages* are tabulated at the destination RCMP and sent back to the source RCMP.
Step 7: The source RCMP makes the decision about which path to select using path based QoS parameters. If multiple paths match the QoS requirements, then the lowest cost factor would decide the best path.
Step 8: Now specific resource reservations are done along the selected path. The reservations done in the first round make sure those resources are not lost during the probing phase. Other RCMP paths time-out on the reservations and automatically release the resources.
Step 9: The path set-up and resource reservation message is sent downstream along the selected path. The reservation confirmation and label information comes back in the upstream direction and full label-switched path is set-up.

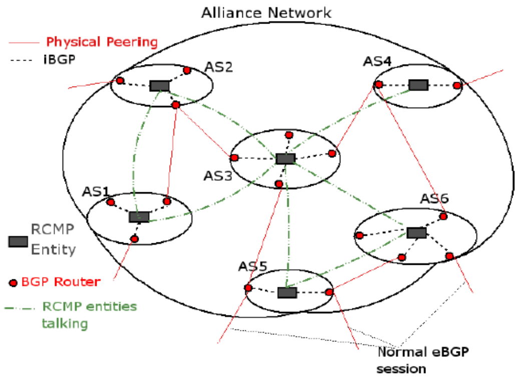

Figure 2 Routing paths of QoS within RCMP

In the given paper PMIPV6 Route Optimization for inter and intra Domain Routing using signaling Reduction approach in LTE Networks the author Wen-Kang Jia(2015) has mainly worked on about signaling reduction in Long Term Evaluation (LTE) Networks. The Proxy Mobile IPV6 is a network based mobility management protocol with LTE. Route Optimization is proposed in order to reduce signaling. By signal reduction low latency Route Optimization can be expected[9]. Long Term Evolution (LTE) is an emerging wireless access technology and is an Internet Protocol (IP) based cellular network. The use of IP is very essential as it provides mobility support to a mobile node (MN) roaming between heterogeneous networks. In order to reduce the signaling messages of MIPV6 route optimization from Return Routability Procedure (RPP) overload Route Optimization Scheme is introduced for LTE. With the help of Route Optimization, the overall performance of mobility management schemes can be improved irrespective of the mobility environments in which the MNS reside. In route optimization performance in terms of the route optimization latency, end-to-end latency and signaling cost is improvised when compared to previous mechanism. The data transport rates are improvised. Binding update and high latency Route Optimization seems to be expensive due to security needs and excessive mobility signaling messages. The Route Optimization is evaluated through simulations. Inter-domain handoff and route optimization does not establish connection RO to CN through complicated RRP instead it originates the datagram packet with route optimization path directly. The datagram packets are expected to reach the CN in the path. In the Figure 3 it shows Intra–Domain Routing and Route Optimization is done for internal routing within the access network and it is transmitted via PGW with the help of bidirectional tunneling. Due to it there is increased packet overhead and delay in the process to solve this issue pinball routing algorithm is used such issues can be avoided with the help of routing mechanism. By Route Optimization technique it has reduced deployment complexity of both network entities, reduces signaling cost, shorter route optimization latencies and feasible implementation. [3]

Algorithm:

1. When it is attached to MAG in the initial stages with the help of access security control the MN – Identifies (MN-10) of Mobile Node is authenticated on the network to be accessed.
2. When the access authentication of MN Identifier (MN-10) becomes successful it obtains the MN's Profile.
3. The current location is sent to the LMA of Mobile Node with the help of MAG by sending Proxy Binding Update (PBU).
4. MN – HNP (Home Network Proxy) assigned by LMA on receiving the PBU message. A binding cache Entry is created which binds the Proxy- Care of Address of MAG along with MN-HNP.
5. A bidirectional tunnel to MAG is established and a PBA message is sent including MN- HNP.
6. On receiving the PBA message, a tunnel is set up between MAG & LMA.
The Router Advertisement (RA) sends message to MN on the access link. The MN-HNP is advertised as the horst.
7. The Mobile node configures the IP address on receiving RA messages. When configuration process is complete MN uses the IP Address for Packet delivery.
8. MAG preu sends a deregistration PBU when the MN moves into the area of MAG new to LMA.
9. PBA message is sent to MAG preu when LMA receives De Reg PBU

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Step 5: A bidirectional tunnel to MAG is established and a PBA message is sent including MN- HNP.
Step 6: On receiving the PBA message, a tunnel is set up between MAG & LMA. The Router Advertisement (RA) sends message to MN on the access link. The MN-HNP is advertised as the host.
Step 7: The Mobile node configures the IP address on receiving RA messages. When configuration process is complete MN uses the IP Address for Packet delivery.
Step 8: MAGprev sends a De-Registration PBU when the MN moves into the area of MAGnew to LMA.
Step 9: PBA message is sent to MAGprev when LMA receives DeReg PB

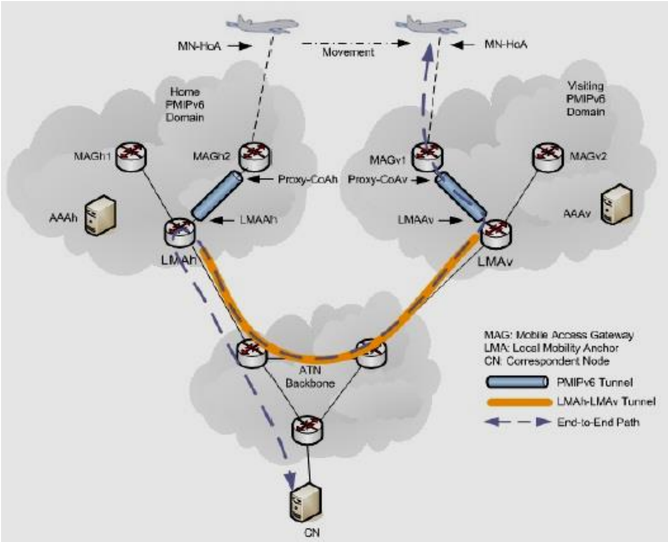

Figure 3 Architecture of Route optimization

In the paper MLV: Multidimensional Routing Information Exchange Mechanism for Inter-Domain SDN the works of the authors Ze Chen, Jun Bi, Yonghong Fu et.ol is related to SDN and the challenges faced in using SDN. The paper gives various ideas on how Inter-Domain routing is done in SDN using Exchange mechanism. SDN is mainly used in Intra-Domain Networks like enterprise network, data centers and content provider networks. It mainly separates the tightly coupled network control and data forwarding functions. Usage of SDN in inter-domain is big challenge. In the published paper in order to improve Internet routing flexibility SDN is introduced to inter-domain network[11]. In order to satisfy all the given conditions Multi dimension Link vector network view exchange mechanism is proposed to exchange the fine grained Inter-Domain routing information and enable programmable Inter-Domain routing[6]. Even though Inter-Domain routing uses Border Gateway Protocol to exchange inter-domain routing information between the Autonomous System(AS).The paper is mainly about the short comings of inter-domain routing exchange protocol BGP: i) The routing policies depend upon the destination IP prefixes. The routing needs to be distinguished by source address or some other fields in packet header to optimize inter-domain routing path ii) It becomes tough for BGP to provide multi-path inter-domain routing because it can proceed in only one way for each IP prefix. Iii) It doesn't provide flexible inter-domain network as the BGP chooses shortest AS path for inter-domain routing. The MLV mechanism is based on five aspects which is Virtual Network View Abstraction, Network View Storage, Initialize and Periodic Updates, Exchange Algorithm and MLV Exchange Example. The hop-by-hop network view exchange mechanism is give in the Figure 3 which is a multidimensional network view mechanism. In this the AS sends its prefix and link paths to its neighbors, it receives a prefix and it stores the prefix and all paths. By this MLV exchange mechanism it reduces the huge fine-grained network.
Algorithm:

Input: AS Topology with AS relationship

Output: Send Link Vector Messages to neighbor ASes

Step 1: Process2: When receive message from recvAS
Step 2: recvPrefix = message.getPrefix();
Step 3: recvLinkList = message.getLinkList();
Step 4: **for all** *sendAS ∈ neighborSet* **do**
Step 5: **if** *ExchangeCondition* == *TRUE* **then**
Step 6: port1 = localAS.getOutPort(recvAS)
Step 7: port2 = localAS.getOutPort(sendAS)
Step 8: intraLink=getVirtualLink(port1, port2, periodVersion);
Step9:interLink=getInterLink(localAS,sendAS, periodVersion);
Step 10: SendList = recvLinkList + [intraLink, interLink];
Step 11: /*filter known link-prefix*/
Step 12: **if** *recvPrefix ∈ knownPrefixSet* **then**
Step 13: **for all** *link ∈ SendList* **do**
Step 14: **if** (*link, recvPrefix*) *∈ linkPrefixT able* **then**
Step 15: currentVersion = linkPrefixTable. getVersion(
link, recvPrefix);
Step 16: **if** *currentV ersion ≥ link.getV ersion*()
then
Step 17: SendList.remove(link);
Step 18: **else**
Step 19: knownPrefixSet.add(recvPrefix);
Step 20: newMessage = Message(recvPrefix, SendList);
Step 21: sendMessage(sendAS, newMessage);
Step 22: /*update in link-prefix table*/
Step 23: **for all** *link ∈ newLinkList* **do**
Step 24: linkPrefixTable.update(link, recvPrefix);

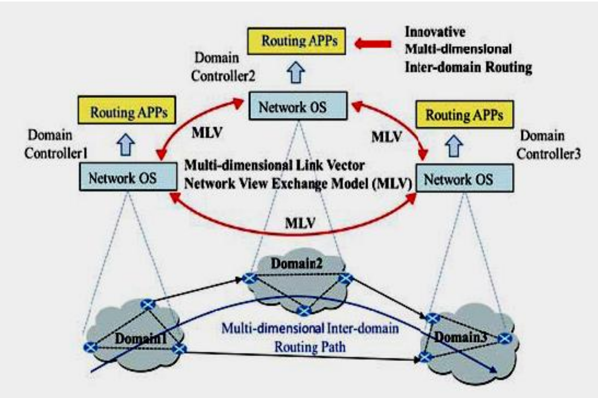

Figure 4 Linking Vector Messages to neighboring ASes

A LCRA Based On Load Balancing for LEO Satellite Networks. The works of Xinmeng Liu, Xuemei Yan et al (2015) have worked on LEO satellites. This paper aims to give a better understanding of LEO (Low Earth Orbit) satellite network designs. It presents the LEO satellite network model along with the proposed algorithms. The need for LEO satellites is increasing enormously in this decade. This paper proposes a low complexity distributed algorithms (LCRA) to improve the performance of LEO satellite networks which include all elements & aspects of it[12]. It is based on load balancing which meet the requirements of QOS(Quality of service) in which congestion is detected, queue delay is reduced & there is a decrease in packet loss rate. The estimation cost is also reduced due to the absence of iteration process. The main goal of low complexity routing algorithm is to deploy the mesh architecture and avoid the congestion. A large number of satellites are required for global coverage. These satellites together form a network system which is called as satellite constellation. Iridium like satellite constellation is taken into consideration in this paper. The altitude and inclination of the orbit are set to 780 and 86.4°. The constellation of LEO satellites consist of a number of satellites in circular orbit. Every satellite node is assigned with four ISLS which consist of two intra plane ISLS which are maintained for the whole satellite orbit perio with its length fixed and two inter plane ISLS which are broken when they are set above the given threshold. Each node is provided with a unique number. The LRCA consists of 2 phases: Routing estimation and Routing optimization & modification. In routing estimation, the next hop is determined when the packet reaches the current node. The choice of the next hop will differ due to the different connections between the current node and their destination. In routing optimization, queue delay is introduced to optimize the path, which in turn improve the delivery ratio. By reducing the end to end delay, the queue delay is reduced. A new mechanism is introduced to modify the routing path without increasing the number of hops. Due to the circular feature of the orbit plane, packets can be transported in both upward and downward direction and the destination is selected based on the shortest path. Performance evaluation for the traffic load model is done by simulation result analysis (NS2) and it is compared to the traditional DSA (Dijkstra shortest path) and DRA (Datagram routing algorithm) which apparently prove the benefits of the proposed algorithm. The connection structure of the satellites and their deterministic movements around the Earth is shown in Figure 5 which simplifies the design of efficient and robust routing algorithms for datagram traffic. First we give definitions **and** theorems which will be used for the new routing algorithm.

Algorithm**:**

Step 1**:** Every satellite has two neighbors in the same plane as well as in the adjacent planes**.** The direction of the neighbors in the same planes of orbital movement is labeled **as *up*** and in the opposite direction **as *down*** and that of in the adjacent planes is called ***left*** and ***right*** neighbors.
Step 2: The satellite network is said to be in initial alignment if all satellites with satellite number k (satellites on one side of the seam) and satellite number (Ad - k - 1) (satellites on the other side of the seam) are positioned at the same latitude. All inter-plane **ISLs** are parallel to the Equator and the **d l** satellites are exactly in the centers of their local location.
Step 3: The satellites on the same latitude with the initial alignment and the **ISLs** connecting them constitute a ***horizontal ring*** **as** shown in Figure **1.** The two horizontal rings closest to the polar regions are positioned at the latitude ***latm;,.*** Note that the difference between the horizontal rings and latitudes is that the horizontal rings may have different latitude values **as** the satellites move.
Step 4: Any source destination satellite pair in the network can be connected by using ***multihop paths.*** Let a multihop path Pso+sn be defined **as** the ordered list of links {Zssl} such that forms **an** n-hop path from source satellite *SO* to destination satellite Sn.
Step 5: The ***total propagation delay*** Dp on the path *P* is simply the sum of all individual propagation delays on each hop of the same path.

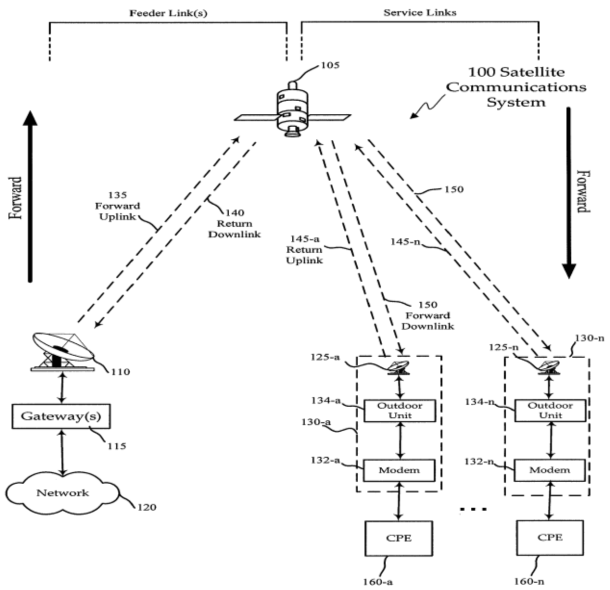

Figure 5 LCRA Algorithm

RESULT AND CONCLUSION

Inter domain routing is routing between routing protocols in different networks. The main inter domain protocol is BGP. Intra domain is routing within a given network. Inter domain routing is in regards to content delivery and mobility. It is mainly used for pocket data transfer to be done efficiently Intra domain routing is mainly for forwarding functions and mainly helps in the separation of tightly coupled network. Inter domains is mostly used to multicast between the internet domains. Inter domains are mainly for control & forwarding and mainly for delivering IP packets over a network. The main issues faced with inter and intra domain routing is network traffic, packet loss and congestion which can be reduced by taking alternative measures. Route optimizations are major factors in intra and inter domain routing which involves the most cost efficient route for optimization. It takes the shortest path between two points.

The following table summarizes the various routing techniques, performance of the metrics and their due remarks.

Table 1: Comparison between various Inter Domain and Intra Domain Routing Techniques

S.no	Author	Technique	Metric	Remarks
1	Adrian Lara et all(2016)	Inter-Domain cut through switching using Software Design Network (SDN)	Data flow control	Optmization problem is solved.
2	Emmanuelle Anceaume et all(2015)	Reputation mechanism	QoS of Internet Traffic	Efficiency of inter domain qos routing is improved.
3	Wen kang Jia(2015)	Route optimization scheme	Route optimization	Reduced signalling cost, feasibile implementation and deployment.
4	Zechen et all(2015)	Multi dimension link vector network view exchange(MLV)	Network traffic	Internet routing flexibilty is improved
5	Xinmeng liu et all(2015)	Low complexity routing algorithm(LCRA)	Packet loss, congestion	Mesh architecture is deployed and congestion is avoided.

CONCLUSION AND FUTURE WORK

Routing is the process of moving data packets from the source to destination in a pattern. Routing process is performed with the help of router. The survey summarizes various techniques on how inter and intra domain routing is being done and gives in a clear view about the various routing techniques used in order to avoid congestion, loss of data and loss of packet data. From the given survey we can say that in inter and intra domain routing there is a large amount of internet traffic which can be controlled by efficient packet data delivery and congestion control. The amount of packet data sent can be reduced. Congestion is mainly due to the excess loan on the network.

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