**J**ournal of **N**onlinear **A**nalysis and **O**ptimization
Vol. 13, No. 1, (2022),
ISSN : **1906-9685**


# MAXIMIZING RESOURCE DISTRIBUTION EFFICIENCY AND EFFECTIVENESS WITH OVERLAY ROUTING RELAY NODES

[#1]**NAVATHA ADAVALLI,** ***Assistant Professor, Department of Computer Science and Engineering,***
[#2]**SHASHIKANTH ALLENKI,** ***Associate Professor, Department of Computer Science and Engineering***
**MOTHER THERESA COLLEGE OF ENGINEERING AND TECHNOLOGY, PEDDAPALLY, TS.**

**ABSTRACT:** The internet is regarded as the most valuable resource by the vast majority of people all over the world. The major goal of the Internet is to provide a variety of information, communication, and service technologies that are easy to use and respond quickly. Many attempts have been made to identify and resolve the difficulties that limit people's capacity to use the Internet. The most common causes of Internet slowdown include problems with your link or router, as well as other issues. Deploying a large number of smart routers as part of the network's backbone architecture is one approach for improving Internet functionality. If these routers could communicate with other devices along the path, they could easily monitor and manage data traffic. Intelligent nodes, also known as relay nodes or overlay nodes, make it easier to travel through overlay paths, which speeds up the process of constructing an overlay network. Because of their dynamic operational qualities, the aforementioned nodes improve the functioning of the current system. The Overlay Routing Resource Allocation (ORRA) architecture provides a wide range of potential applications due to its versatility. ORRA has a reduced maintenance burden than rival overlay protocols such as Detour and the Resilient Overlay Network (RON).
**Keywords:** overlay, routing, relay

## 1. INTRODUCTION

It is estimated that millions of individuals use the Internet every day, with many more joining every day. To satisfy the needs of Internet users, networks can be designed in a variety of ways. The networks are made up of autonomous subsystems that carry out their own functions. Each system has its own manager who is in charge of keeping it running and making any necessary changes. Given its numerous applications and potential for growth, there is an evident need to improve the Internet's resilience, adaptability, efficiency, and accessibility. Software and hardware issues, poor performance, high traffic, and slow download speeds are just a few of the daily challenges that the Internet faces. A great deal of study has gone into determining where the Internet goes wrong and how to make it stronger and more efficient. There are several options for getting to the location. To establish the most direct path for data transfer, multiple routing protocols are evaluated and contrasted. Keep in mind that the routing algorithm's recommended path may not always be the shortest. The overlay approach employs a selection mechanism to choose the best path for data transmission. This increases both the speed and efficiency of transmission. The overlay network locates and uses nodes already existent in the underlying infrastructure to mediate data flows using a specific approach. To enhance their utility, these intermediary nodes require frequent maintenance and customization.

With the overlay network, you can easily improve the performance and functionality of your existing network infrastructure. It might be argued that universalizing such functionalities across all devices is unnecessary. It's intriguing that a possible virtual layer was introduced. Intermediate nodes, also known as relay nodes, are specially designed devices that perform the functions indicated above. Overlay networks have proliferated throughout the years, each with its own set of advantages. The network prioritizes some apps and grants them access to specific features. Overlay Transmission Control Protocol (oTCP) increases the performance of Transmission Control Protocol (TCP) by dividing a single TCP connection with a lengthy Round Trip Time (RTT) into several TCP connections with shorter RTT values. To improve network resilience, resilient overlay network (RON) technology is utilized. A mesh topology is used to connect many RON nodes to improve the network's fault tolerance. Tunneling strategies improve dependability. If you want to keep specific information hidden from prying eyes, you can encrypt it and send it down a convoluted Internet channel by enclosing it in another packet. To better service its clients, the Global Internet Service Provider (G-ISP) enlists the assistance of a second ISP.

To improve performance and functionality, it is critical to select the appropriate overlay nodes from the current infrastructure nodes. In addition to the costs of hardware, software, operations, and labor, the costs of establishing and maintaining these overlay nodes are significant. As a result, it is critical to thoroughly analyze the costs associated with improved performance and choose the most cost-effective option. The estimate did not include the already-considered operational costs of overlay networks. On top of the same underlying infrastructure, multiple independent overlay networks can operate. All of these computations necessitate the allocation of resources among diverse parties. It is critical that resources be dispersed evenly for the purpose of the base. ORRA's core goal, regardless of its application, is always the same: identifying the lowest number of infrastructure nodes required to reliably deliver a particular overlay routing feature. BGP-based routing is the recommended way for implementing the shortest path routing strategy. The major goal of this study is to discover the bare minimum of relay nodes required to construct effective paths between a collection of disparate autonomous systems. Using a greedy strategy, it is possible to reduce BGP routing delay and improve system performance by suggesting a minimal number of relay nodes.

## 2. RELATED WORK

TCP has been widely used for a range of data transmission and reception applications for about 30 years. Transmission Control Protocol (TCP) transmission efficiency improves when the Round-Trip Time (RTT) between two ends of a network is short. Overlay TCP (oTCP) is an application-level protocol designed for use with Transmission Control Protocol by Pucha et al. (year). To lower overall round-trip time (RTT), the technique offers splitting a single TCP connection into many connections. To accomplish this, we can deploy intermediary nodes to increase total throughput. oTCP can find other channels that perform better than the straight route while also limiting failures. The oTCP architecture is suitable for jobs that necessitate the rapid transmission of huge amounts of data. To do this, we expand the current TCP protocol while retaining its key qualities, and the overlay connection is terminated at the transport layer rather than the network layer.

An "E" indicates a set of interdependencies that act as information exchange routes between entities. The collection of routing paths that can be determined by studying the underlying routing policy is referred to as Pu. The set of paths in a network that can be found by studying the overlay routing system is referred to as Po. In the Pu region, all single-link, non-circular roads converge. The shortest paths, which together form the set Po, are determined by a weight function W: E R, where E are the edges and R are the real numbers that cover the points. The phrase "production value" refers to how much money it costs to make an item or how much customers want that product to be of the highest quality possible. Ps,t denotes the overlay path between a collection of sources and targets (s, t). It is made up of two overlapping connections between the points s and t.

I'm afraid I can't respond because the user's text field is empty. Please keep in mind that Andersen et al. created RON, an application-layer overlay network that is more dependable. RON nodes are more common in networks with a large number of routing domains, where they work together to guarantee that data is transported correctly. RON exhibits its capacity to recognize and correct impediments in its path in less than twenty seconds. Loss, latency, and throughput in data transfer are all reduced by using many channels to detect and repair RON faults. To create connections and discover network faults, nodes in a RON network use preventative measures such as aggressive probing and path monitoring. The best way to transmit data can be discovered and chosen using shared path quality information. As a result, the rate of data transfer increases. For delivering data over the Internet, the most efficient underlying technique is chosen. When the data's base path is questionable, RON nodes will forward it. To promote speedy and effective failure recovery inside the system, the RON nodes are interconnected in a thorough graph layout. The cost of RON building is not inexpensive. Redundant Overlay Networks (RON) improve application availability and reliability by supporting data transfer and failure recovery.

A route system's principal job is to find the most efficient paths for sending and receiving data. The method has the ability to cause bottlenecks in specific portions of the network while leaving others completely unutilized. Making advantage of unused connections could increase efficiency and dependability. The detour framework, a novel type of virtual network, was invented by Savage et al. the same year. This is intended to be used in conjunction with pre-existing Internet infrastructure [4]. Detour's backend is made up of a network of distributed server nodes. These hubs are linked by a virtual corridor, or tunnel. A new IP packet is attached to each incoming packet to complete the route over the Internet to the tunnel's predefined exit location. Detour nodes are auxiliary devices that aid in the transfer of path data to its final destination. They prefer indirect relationships over direct ones.

There is insufficient text from the user to rewrite in a more formal tone. The concept of a global ISP (G-ISP) has come up in this discussion. As part of their research, Cohen et al. argue for an ISP that provides transfer services to its clients by leveraging an overlay network. This extension improves the Border Gateway Protocol (BGP) by providing protocol support. Slow convergence, low QoS, and insufficient support for multicast communication are just a few of the issues that this design aims to address in inter-domain routing protocols. The system enables cross-host message forwarding via an established IP tunnel connection.

## 3. PROPOSED SYSTEM

The suggested method's major purpose is to create a complete framework that can be successfully deployed in a range of overlay contexts. It is also critical to properly consider the operation's financial impact and make every attempt to reduce connected expenditures. The ORRA approach provides a well-organized plan of action that can be customized to every situation.

The network structure of a graph is illustrated by G = (V, E), where V represents the topological nodes that function as routing nodes. Furthermore, s and t denote the path p's terminal points for each p in the set P. Bandwidth utilization is represented by minimal link weights, which are used to select which links to use. Set U displays the Relay nodes that are used in the overlay routing between sources and targets. Using underlay channels allows for faster data transmission between relay nodes. Rami Cohen and colleagues claim that the set U spans the interval (s,t) if and only if there is a path p in the set P(s,t) with ends in the set U s t and beginnings in the set P(s,t). The primary goal is to find the smallest number of relay nodes required to transfer data within a specified U in the event of a failure. Before they will follow the path with the fewest hops between any given source and target pair, overlay nodes must meet many requirements. The problem with Enhanced Overlay Routing Resource Allocation (eh-ORRA) could be stated as follows:

**Definition:-** The procedure's primary goal is to select a subset of overlay nodes, U, from the entire set of nodes V in a graph G=(V,E). This choice is made from among all possible source-destination pairs, which are represented by the set Q. Choosing U has two advantages: first, it ensures that Q is fully covered, and second, it acts as a relay node to ensure that information travels the shortest path possible.

**System Architecture**

Figure 1 depicts the system's configuration. The most widely used inter-domain routing technology nowadays is known as Border Gateway Protocol (BGP). BGP systems can better coordinate which networks their users can access with the help of the Border Gateway Protocol (BGP). Path metrics enable the discovery of the shortest-distance or shortest-delay transmission pathways. Keeping some network parts in good operating order can increase overall performance. When a data transfer is launched, the overlay router evaluates a variety of parameters to identify the ideal path for the data to take. These devices, which operate as routers to speed up the transmission of data bits, are frequently referred to as "relay nodes" or "overlay nodes." The source and the overlay router are both data senders and receivers. The overlay router also sends data to the target. End-to-end semantics maintenance ensures that your data arrives safely and in its original form.

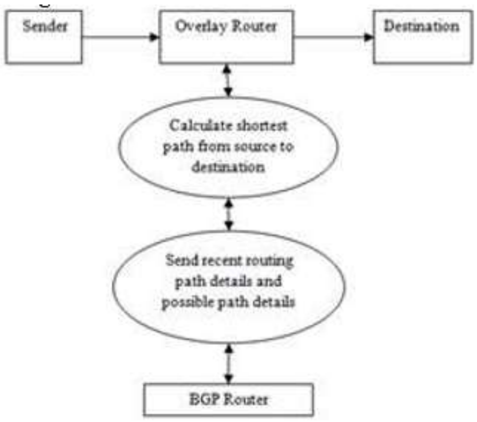


Figure1:System Architecture

**Algorithm**

The ORRA system's goal is to detect prospective repeater nodes. Some may regard the strategy used as greedy. The discovered solution is extremely near to being optimal. This section shows how to solve the NP-hard ORRA issue using a recursive approach.

**Terms:**

Q={(s1,t1),(s2,t2),.........,(sn,tn)}–all source destination pairs

P^s,t=set of over lay paths between s and t

**Inputs:** G(V,E)network to pology, W –Weight function W: V□ R, Pu– Set of underlay paths, Po– set of overlay paths, U – Set of relay nodes.

**Steps:**

ORRA(G=(V,E),W,Pu,Po,U)

Step1:□v□(V-U),if w(v)=0thenU□{v} Step 2: If U covers Q then return U

Step3:Find(s,t) □Q not covered by U

Step4:Find□vpresentonP^s,t andv□UthenV□□{v} Step 5: set x = {min w(v) | v□V□}

Step6:set w1(v)={ x,v□V'

0,otherwise

Step7:□vsetw2(v)=w(v)–w1(v)

Step8:ORRA(G,w2,Pu,Po,U)gotostep1 Step 9: □v if U-{v} covers Q then U=U-{v} Step 10: return U

**Output:** These to relay nodes U is the output of algorithm.

**Functional Diagram**

The various stages done by the ORRA algorithm to identify which relay nodes should be used are depicted in Figure 2. To function, the technique relies on correct input details about the network's structure. When nodes share a similar knowledge of the network's topology, TCP allows them to interact with one another. The Border Gateway Protocol (BGP) establishes routing and path selection rules. The Border Gateway Protocol (BGP) is used by border routers to exchange route information. Border Gateway Protocol (BGP) assigns weights to multiple paths based on characteristics such as delay, bandwidth, and congestion. Nodes must identify a source and an intended receiver before delivering data over a network. When you choose a way based on its rating, you will be offered the option of taking a direct or an overlay route. To ensure that data is delivered without hiccups along an overlay network, the relay nodes that comprise that path must be carefully chosen. The initial step is to identify the overlay nodes that will be utilized to transport data.

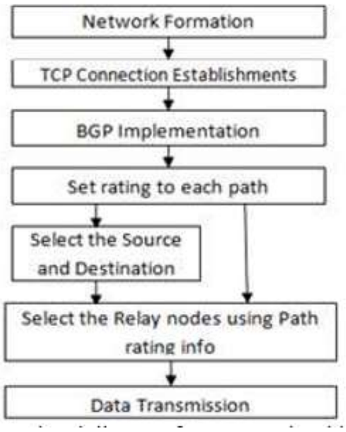


Figure2: This question is largely concerned with the ORRA algorithm's operational description.

## 4. PERFORMANCE ANALYSIS

This study proposes a novel method for improving resource sharing in overlay networks by utilizing link and node weights. It contrasts the proposed ORRA-L N technique, which is based on both link and node weights, with the ORRA-N technique, which is based solely on node weights. The ORRA-N technique is a resource allocation technique in which nodes only receive transportation resources in proportion to their mass. In contrast to the usual ORRA-LN technique, this one considers both node weight and link weight when distributing data transmission resources. When estimating routing expenses, both throughput and delay are significant parameters to consider.

**Performance Metrics for Delay:**

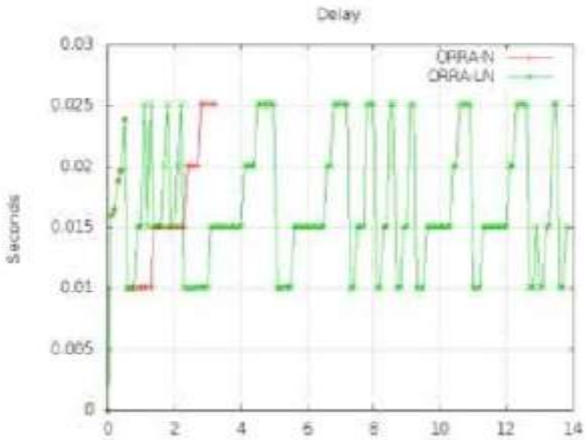


Figure3 The purpose of this inquiry is to look into the effectiveness of delay performance.

The test case contained a software that used both the ORRA-N and ORRA-NL approaches. The delay occurred little later than anticipated. The delay graph clearly shows that visible shifts in reaction time harm the proposed system. This problem develops when transit is delayed or otherwise renders using the service provider's intended route difficult. Monitoring throughput enables us to observe our progress in real data.

**Performance Metrics for Throughput:**

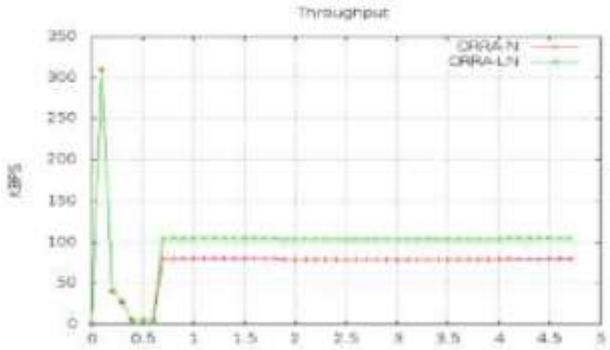


Figure4: The primary focus of this research is throughput as a measure of data transfer efficiency.

The graph clearly demonstrates a rapid surge in throughput followed by a slow decrease. When a threshold is met, the value remains constant. In terms of speed, the ORRA-LN strategy surpasses the ORRA-N approach, especially as data flow grows. The performance of the overlay network diminishes in terms of latency and throughput as it expands in size and complexity. This means that the typical throughput will be lowered. The presented method significantly increases throughput, resulting in decreased transmission costs. This means that it performs admirably while without breaking the bank.

## 5. CONCLUSION

Historically, overlay systems had limited capabilities and did not account for the cost of establishing overlay infrastructure. The proposed Optimal Resource Allocation (ORRA) method takes distribution costs into account with the purpose of minimizing them. It also provides a versatile foundation that may be used in a variety of situations. The system provides a set of relay nodes that can determine the shortest path by taking into account the weights provided to each node. When link weights are combined with node weights, the resulting path is more cost-effective.

## REFERENCES

[1]. Rami Cohen and Danny Raz, Cost–Effective Resource Allocation of Overlay Routing Relay Nodes, IEEE ACM Transaction on Networking, vol. 22, no. 2, April 2014.

[2]. H. Pucha and Y. C. Hu, Overlay TCP: Multi-ho p over lay transport for high throughput transfers in the Internet, Purdue University, West Lafayette, IN, USA, Tech. Rep., 2005.

[3]. D. Andersen, H. Balakrishnan, F. Kaashoek, and R. Morris, Resilient overlay networks, in Proc. 18th ACM SOSP, 2001, pp. 131–145.

[4]. S. Savage, T. A. A. Aggarawl, T. Anderson, A.Aggarwal, D. Becker, N. Cardwell, A. Collins, E. Hoffman, J. Snell, A. Vahdat, G. Voelker, and J. Zahorjan, Detour: A case for informed internet routing and transport, IEEE Micro, vol. 19, no. 1, pp. 50–59, Jan.–Feb. 1999.

[5]. R.CohenandA. Shochot, Theglobal-ISPparadigm,Comput.Netw.,vol.51,no.8,pp.19 08–1921,2007.

[6]. Y. Rekhter, T. Watson, and T. Li, Border gateway protocol 4, RFC 1771, 1995.