Performance evaluation of IPv4-IPv6 tunneling procedure using IoT

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Abstract: It has become a high need for specialist co-ops, endeavors, IP apparatuses producers, application designers, and governments to start their organizations of IPv6. Consistent movement from IPv4 to IPv6 is difficult to accomplish. Along these lines, a few instruments are required which guarantees smooth, stepwise, and free change to IPv6. Not exclusively is the change, yet the reconciliation of IPv6 is likewise required into the current systems. The arrangements are to be partitioned into three classes: Tunneling, Dual-Stack, and Translation. Numerous individuals believe that NAT is a superior methodology yet Tunneling is a liked and most adaptable approach to convey IPv6 in existing IPv4 situations. IPv6 can be empowered any place IPv4 is empowered alongside the related highlights needed to make IPv6 routable, exceptionally accessible, and secure. These current places of business the difficulties as far as availability, security, portability, and unwavering quality. The paper centers around the future works and vision expected to execute the Internet of Everything to arrive at an interoperable, trustable, versatile, conveyed, significant, and ground-breaking empowering agent for rising applications. The overall accuracy of the methods is calculated for transmitted packets during transmission and delay of the packets at different data rates. So there is a huge improvement at a higher data rate. Hence, the examination of IPv4, 4to6 passage, and IPv6 systems present us with their exhibition qualities through measurable investigation. The insights acquired from reproduction give us that the throughput execution of IPv6 is far superior to IPv4 and 4to6 passage. IPv6 performs better under explicit occasions. By considering the exhibition gauges the IPv6 convention has better transmission proficiency and high throughput. Quantitatively, the proposed method has outperformed 51.19% for different data rates and 18.90% for the same data rate in the case of IPv4. 64.34% for different data rates and 35.53% for the same data rate in the case of IPv6. 61.43% for different data rates and 29.27% for the same data rate in the case of Tunneling.

Keywords: IPV4, IPv6, IoT Objects, Tunneling, Cisco Packet Tracer, GNS-3, Wire shark.

1. Introduction
Sometimes, IPv6 isn't empowered on a particular interface or gadget due to the nearness of heritage applications or hosts for which IPv6 isn't upheld. Conversely, IPv6 might be empowered on interfaces and gadgets for which IPv4 upholds is not, at this point required. Growing the IPv4 convention suite with bigger location space and characterizing new capacities reestablishing start to finish availability, and the start to finish benefits, a few Internet Engineering Task Force (IETF) working gatherings have chipped away at numerous organization situations with models to connect with IPv4 foundation and administrations. They have likewise upgraded a mix of highlights that were not firmly planned or
adaptable in IPv4 like IP portability, impromptu administrations; and so forth providing food for the outrageous situation where IP has become an item administration empowering most reduced expense organizing organization of enormous scope sensor systems. This incorporates RFID, IP in the vehicle, and any believable situation where systems administration increases the value of the item. Along these lines, the new origination of stretching out the Internet to everything has been made achievable by IPv6. It spreads tending to space to help all the rising Internet-empowered gadgets.

2. Internet of Things (IoT)

Internet of Things natural frameworks are made, from one point of view, of implied quick articles, i.e., a little and especially obliged physical contraptions of networking concerning memory to restrain, calculation capacity, essentialness freedom, and correspondence capabilities [3, 18]. Internet of Things is comprised of recognizing verification names, classes, variants and codes that allow recognizing a specific thing interests and universally. Web developments and contraptions, for illustration, cell phones, tablets, PCs, cutting edge props, devices, and building Robotization are moreover seen as a major angle of the net of things. This modern start of broadening the Web of everything is an achievable appreciation of the unused frame of the Web Convention (IPv6). IPv6 spreads the tending to space to assist all the creating Internet-empowered contraptions. IPv6 has been expecting to allow secure and effective correspondences to clients and transportability for all contraptions added to the client; in this way, clients can, by and large, be connected. IPv6 highlights are what have made it conceivable to think around the Internet of Things.

The cozy association between the computerized and the physical world engaged by the Web of Things passes on with its weaknesses regarding security and protection. It is additionally ready to arrive at our vitality frameworks, physical access control frameworks, and in any event, when we go across the road in a brilliant city. In this way, protection and security are considered critical issues for the Web of Things. Security is as of presently thought to be a major issue within the current advanced society, and some courses of action and rebellion have been built [14, 15]. Consequently, some portion of the way is now cleared, the significant test presently is the way to stretch out these instruments to the Internet of Things gadgets, characterize new systems more centered around personality and protection, and the most significant test, how to make them versatile and doable for a future with billions of gadgets.

3. Why an Internet of Everything?

IoT drives towards planning everything into the Web Center, this design is the named Web of Everything. The combination of everything is induced by the advertise wish to have all cycles remotely accessible through a uniform medium – while simultaneously understanding that rebuilding a foundation to permit this for every application freely would be restrictively exorbitant and time-100. Besides, the current development from uniform mass business sectors, to customized ones, where the customization and client determined variation is a prerequisite, makes such a uniform framework found on the Internet, basic. It permits numerous parts to be reutilized and administrations to be shared and abbreviated usage times [21, 22].

4. Literature Survey

Saiyan KM [1] et al expressed that IPv6 was intended to assist +340 undecillion (2128) Web Convention addresses differentiated and 4.3 billion (232) IPv4 addresses. On the off chance that the evaluation of everybody in this world (6.77 billion) will require 3 IP addresses for each person, at that point inaccurate the total required IP addresses for all the people around the globe, which is 6.77billion x 3 = 20.31 billion IP addresses. Wu. P [2] et al informed that the cycle regarding the change from IPv4 to IPv6 has gotten inescapable and genuinely earnest. The creators presented the standards of burrowing and interpretation procedures and broke down the essential issue of heterogeneous crossing and heterogeneous interconnection in IPv6 change, and audited the standard burrowing and interpretation systems. Meena C R, Bundele M[3] proposed that IPv6 is acknowledged because it could comprehend the
movement of IPv4 assets to IPv6 organize, just as shared correspondence between the two contradictory conventions has not evolved and conveyed. Chauhan D and Sharma S [4] in their paper contemplated that the IPv4-IPv6 existing together systems ought to continue the accessibility of both IPv4 and IPv6, and backing IPv4-IPv6 interconnection also. S K Srinidhi [5] prescribed that moving from IPv4 to IPv6 isn't straight-forward because IPv4 and IPv6 are hostile conventions. To empower the clear progress somewhere in the range of IPv4 and IPv6, different change systems have been proposed by IETF.

Saklani An and Dimri C.S[6] proposed that IPv4 will be killed and IPv6 turned on the two conventions together with no complexities. Antonio J.Jara[7] et al. introduced the future works and vision that portray the guide of the Internet of Everything to arrive at an interoperable, trustable, versatile, appropriated, significant, and incredible empowering agent for developing applications, for example, Smarter Cities, Human Dynamics. Somayya Madakam[8] et al gave a review of the Internet of Things, designs, and imperative advances and their uses in our everyday life. Wesan almobaiden[9] recommended that another methodology in creating geological courses that are best presented with close clinical focuses. Ala al-faqaha[10] et al proposed the IoT is required to connect various innovations to empower new applications by associating physical items on the side of astute dynamics. Maria Rita Palattela[11] presented on schedule and just because, the remote interchanges stack the business accepts to meet the significant rules of intensity productivity, unwavering quality, and Internet network. Fadi Al-Turjma[12] considered that the complete system vitality whereas picking the taking after bounce for the coordinated bundles within the centered on farther sensor organize. Andrea Zanella[13] suggested an extensive overview of the empowering advancements, conventions, and design for an urban IoT. J.Hanumanthappa[14] et al chipped away at the conjunction of double conventions. Mayekar. B[15] et al proposed one of the techniques for IPv4 hosts to get to IPv6 has is by exemplifying IPv6 bundles inside IPv4, known as Tunneling. This paper plans to quantify and assess the presence of IPv4, IPv6, and Tunneling (6to4) utilizing Cisco Packet tracer 6.1. This PC reproduction execution measure shows the hypothetical correlation as far as deferral, parcel misfortune, and throughput.

5. Technical Gap

IoT and unavoidable mix of clinical conditions delineate complex structure burdens and the got to show up at a sensible movement improvement for its wide sending and advertise coordination from the foremost tried and true early stage, IoT contraptions show got challenges since they are obliged contraptions with moo memory, managing with, correspondence, and significance limits. The fundamental key test for an in general technique is the joining of multi-advancement frameworks in an ordinary all-IP structure to ensure that the correspondence plan is strong and versatile [7, 20,23]. Thusly, IoT depends upon the openness and constancy for its trades on Future Web arranging and the IPv6 appears to cover the tending to and flexibility prerequisites. The consequent key test is to guarantee security, affirmation, the unwavering quality of information, and client confirmation. A gigantic bit of the IoT applications ought to think almost the assistance of parts to do the authentication, bolster, get to control, and key affiliation [11]. Furthermore, since of the decreased limits from the obliged contraptions enabled with Web openness, higher security of the edge amasses ought to be considered concerning the common framework of a network in today’s era. The degree of contraptions that are associated with the Web around the world is creating definitely. This has prompted portraying another beginning of Web, that is the reason why the dependably called Future Web, which started with another sort of the Web Convention (IPv6) that extricates up the tending to space to assist all the making Internet-drew in contraptions [8].

6. Objectives of the work

The main contribution during the research work can be grouped under the following domains:

- To study the existing IPv6 mechanism in the IoT environment.
- To identify the issues of IPv6 using IoT.
- To resolve packet transmission issues and security in IoT.
7. Methodology adopted for the proposed work

In this framework, the first step is designing. For designing graphical network simulator-3 is used to make topology. In this topology design, there are two routers R1 and R2 are connected via fast Ethernet. After designing, the second step is assigning an IP address. There are IP and IPv6 addresses on all the interfaces. On fast Ethernet interfaces, IPv6 addresses are assigned, and on fast Ethernet interfaces. IPv4 addresses are assigned. All the IoT objects like sensor-based fans are assigned with ipv6 addresses. After IPv4 and IPv6 addressing, the third step is Tunneling. Routing is the process used to define the path in different networks in a wide area network. In the framework, dynamic routing is used to create the route. With dynamic routing, the path defines from source to destination is automatically by RIPng. After all the phases in this framework, the last step is testing. In GNS-3 software, Wire-shark is the packet capturing tool is used for testing purpose. In this tool, there is much output taken of packets in graphs and packets.

8. Proposed Work:

In this paper, the creators have proposed a Burrowing Strategy. Burrowing alludes to a handle by which one or more number of switches or has typified the IPv6 parcel interior an IPv4 bundle. The organizing gadgets forward the IPv4 bundle, overlooking the reality that the packet’s payload is an IPv6 bundle. A few afterward gadgets or have decapsulated the first IPv6 packet, forwarding it on to the ultimate goal. To back IPv6 over IPv4 and IPv4 over IPv6 Burrowing, many sorts of burrowing advances have been created.

These advances are portrayed as programmed or designed. Programmed burrows are made and torn down on the fly when in truth designed burrows are predefined. Firstly, we'll be checking on a few burrowing nuts and bolts, after that we are going be clarifying these burrowing sorts. Burrowing of
IPV6 bundles by an IPV4 arrange to incorporate prefixing each IPV6 bundle with IPV4 headers. Due to this reason, the burrowed bundle course over IPV4 directing framework. Embodiment is fulfilled by the switch and passage hub of the burrow. IPV4 address of the source in IPV4 header is populated with IPV4 address of hub and target or goal address is that of burrow endpoint. The convention field of the IPV4 header appears a typified IPV6 bundle, it is set to 41(decimal). The burrow endpoint or exit hub performs decapsulation to strip off the IPV4 header and send the parcel to a goal by IPV6.

8.1 Design and Implementation
The proposed Tunneling strategy has been actualized utilizing Graphical Organize Simulator-3 may be an organized test system, to begin with, discharged in 2008. This computer program permits the collaboration of virtual gadgets and Genuine gadgets.

It makes the utilize of Elements imitating program to reenact cisco associate working framework. Exxon, Walmart, AT&T, and NASA, are huge companies that used Realistic arrange GNS-3 program and is additionally well known for the arrangement of organizing proficient certification exams. Until 2015, the computer program was downloaded 11 million times. This computer program makes a difference you construct all the realistic models of computer systems situation and mimic systems of numerous different levels of complexity. Understudies can utilize this program, who are attempting to get different certifications but by arrange engineers and experts in this field. It comes as an open-source arrangement that runs on all well-known windows. GNS3 comes with a part of point by point documentation concerning its few features and tools, as well as their functionality.

8.2 Description of Technique
In this method, authors have taken the two locations which are connected via IPv6 but the path used by both of the route devices is configured by IPv4 address. IPv4 is an internet protocol address which is a 32-bit address and the meantime issue we have seen there are fewer IP addresses so in the future they will not be able to survive too far. So, for saving IPv4 addresses, the Tunneling method in this process is planned with both IPv4 and IPv6 addresses in the first router that exemplifies the IPv6 group inside an IPv4 group in a short time. Later devices have decapsulated the principal IPv6 bundle, sending it on to a definitive objective. More Internet traffic is expected to be carried via tunnels which are made in between both the ipv6 networks in this on fast Ethernet 0/0 link we will use the only ipv6 and in se0/0 link tunnel will be created.

![Architecture of tunneling with IoT objects](image-url)
This work has portrayed the key components to reach the advancement of network, unwavering quality, bolster for heterogeneity, security, and portability. This area portrays the continuous and future works to proceed upgrading the potential of the IoT.

![Diagram of IPv4-IPv6 Tunnelling]

**Figure 3.** Basic structure of IPv4-IPv6 Tunnelling.

9. **Results and Discussions**

We have designed IoT architecture with routers, switches, and IoT objects like sensor-based fans. Configured and implemented all coding in GNS3 and Packet Tracer. Here are the screenshots of execution codes in GNS3 and packet Tracer 7.0.0.0201 and screenshots of packet output results and also graphs.

![Wireshark output deny graph]

**Figure 4.** Wireshark output deny graph of proposed work.
Figure 5. Wireshark output Permit graph of proposed work.

Table 1. Performance Evaluation with different data rate (mbps).

| PHASE | DATA RATE | THROUGHPUT | DATA RATE | THROUGHPUT | %age Increment |
|-------|-----------|------------|-----------|------------|----------------|
| IPv4  | 64 mbps   | 185.7778   | 100 mbps  | 280.8875   | 51.1954        |
| IPv6  | 64 mbps   | 316.8889   | 100 mbps  | 520.7885   | 64.3441        |
| Tunnel| 64 mbps   | 310.8889   | 100 mbps  | 501.8889   | 61.4367        |

Table 2. Performance Evaluation with the same data rate (mbps).

| PHASE | DATA RATE | THROUGHPUT | DATA RATE | THROUGHPUT | %age Increment |
|-------|-----------|------------|-----------|------------|----------------|
| IPv4  | 64 mbps   | 185.7778   | 64 mbps   | 220.8888   | 18.8987        |
| IPv6  | 64 mbps   | 316.8889   | 64 mbps   | 420.7888   | 35.5349        |
| Tunnel| 64 mbps   | 310.8889   | 64 mbps   | 401.8889   | 29.2709        |

As seen in the above tables the resulting figures are showing the accuracy of the proposed method as compared with the existing method [16]. The overall accuracy of the methods is calculated for transmitted packets during transmission and delay of the packets at different data rates. So there is a huge improvement at higher data rate also as shown in Table 1 and also for the same data rates in table 2, which also outperformed. Quantitatively, the proposed method has outperformed 51.19% for different data rates and 18.90% for the same data rate in the case of IPv4. 64.34% for different data rates and 35.53% for the same data rate in the case of IPv6. 61.43% for different data rates and 29.27% for the same data rate in the case of Tunnelling.

A Comparative examination of Ethernet delay, Packet misfortune, or sent, Throughput dependent on recreation and explanatory methodologies was conveyed in each of the three system situations. In light of this examination, the exploration question was planned to comprehend and research what is the
distinction in the postponement is knowledgeable about IPv4, 4to6 passage, and IPv6 organize or what is best for the client from the Quality of Service site. The reenactment result is IPv4 has a lower delay than 4to6 passage and IPv6, in medium burden traffic the postponement is low between them in high burden traffic the deferral is equivalent. Hence, the examination of IPv4, 4to6 passage, and IPv6 systems present us with their exhibition qualities through measurable investigation. The insights acquired from reproduction give us that the throughput execution of IPv6 is far superior to IPv4 and 4to6 passage. IPv6 performs better under explicit occasions. By considering the exhibition gauges the IPv6 convention has better transmission proficiency and high throughput.

10. Conclusion and future scope
In the IPv4 course, gadgets couldn’t ready to associate after 255 switches because there is a conduct of help for huge scope network from with help for huge scope availability from different physiological sensors, coordination with information systems, and its homogeneous get to through the Web and Web developments from buyer contraptions, for illustration, tablets, cell phones, and workstations. This paper has presented the commitments done to move from a hypothetical IoT to a verifiable one through the capability of IPv6 advancement. The correspondence plan for the Web of Things is made out of the key parts to enable security, compactness, and begin to wrap up network/dependability. Not with the help of the addressing.

IPv6 additionally offers the likelihood of versatile security, portability, and a start to finish availability/unwavering quality. For this reason, the conventions Mobile IPv6 (MIPv6) for versatility, and IP Security (IPSec) for security have been characterized, yet the two conventions have required a lightweight rendition of MIPv6 with help from IPSec to make it appropriate for the IoT environments. In authoritative, the end is that cell phones, individual information terminals, and other portable registering gadgets are still a long way from what a future IoT will need to interface administrations, individuals, and things. Be that as it may, full IPv6 joining is the initial move towards this objective. In the following stages one visualizes uphold for versatility, multi-homing, revelation procedures, and the executive's answers for make things more independent and to empower an interchanges period dependent on the Future Internet of Things, Services, and People, i.e., an Internet of Everything.

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