



Enhancing the Performance of Multiple Wi-Fi Network

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Enhancing the Performance of Multiple Wi-Fi Network

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Abstract : *Multiple Wi-Fi Connectivity Combined to deliver end-to-end network solutions for the wide range of network expansion. Wi- Fi Networks makes use of additional USB Wi-Fi Network adapter to combine the existing Wi-Fi networks to improve the performance of networks . It provides solution to combine Wi-Fi networks and answering the following Network related problems like Resources sharing, Traffic and Security Management in Networks. It increases the performance and efficiency of available networks by managing the various factors like detecting the available Wi- Fi connectivity along with bandwidth for file transfer and measuring the speed and accuracy of using the network resources. Multiple Wi-Fi Networks Combined to find the optimal solution in sharing of network recourses between various network Wi-Fi Connectivity . By making use of 5G LTE AER router we can able to combine more than one Wi-Fi network and by making use of this application to enhance the performance in combine the available network.*

Keywords: *Multiple Wi-Fi Networks, Combining Wi-Fi Networks, Managing various networks and Combining Networks*

1. Introduction

A network is group of two or more devices than can communicate it may possible through wireless connection. Wi-Fi is wireless network based technology with IEEE 802.11 standard used in designing LAN (Local Area Network) to access the internet. The various version of Wi-Fi based IEEE 802.11 standards with available radio bands to achieve wide range coverage with optimal speed, in general its uses 2.40 GHz or 5.0 GHz radio bands. Wi-Fi is supported by various application and devices including home networks, PDA (Personal Digital Assistant), Mobile Phones and many electronic devices. It uses waveband for data transfer and best suited for line of sight location the obstructions like wall etc, will reduce the data rate and increase the interference. In wireless network which uses radio frequencies to connect computers in this devices are allowed to move freely in various dynamic positions (Mobility). Many organizations and companies are now moving towards Wi- Fi connectivity for faster internet access.

2. Wireless Network

Wireless networks are device based networks that are not using cables of any kind for connectivity. Wireless local area network (LAN)[1] uses radio waves to connect various types of devices like laptop , computers and mobility based device to the internet and your network. The telecommunication network layer at the physical level it consist many wireless network elements. Wireless network are constructed using various links they are Microwave communication links

it uses earth based communication and receivers look like satellite dishes which limits all communication to line of sight relay station are placed around 45 km distance, Satellite links uses microwave radio waves in these satellites are positioned in geosynchronous orbit over the equator the system on earth orbits are supported with features like relaying , receiving voice, data and TV signals, Cellular system links uses radio communication technologies these system divides the region into several geographic areas and find the area with low power transmitter also otherwise antenna to relay information or data in the forms of calls from one place to next or adjacent places, Radio and link with Spread Spectrum uses high frequency radio technology it providing connectivity between multiple device in specified area and optical connectivity link uses visible and invisible light for communication purpose in these it uses line of sight for limiting the position of devices. The wireless network survey is the process of planning and designing a wireless network by identify the optimal location for access points to provide the required wireless coverage, maintaining data rate, and quality of services.

Wireless networks also known as ad-hoc network are designed with mobile devices act as host for framing a temporary network without the help of any standalone network recourses like infrastructure to build network. Mobile device based Ad-hoc networks are self-organizing group with network connectivity and self-configuring multiple hop network connectivity in these network structure changes

dynamically. Wireless connectivity based network uses high frequency range radio waves are used to transmit data packet between sender and receiver. The problem is finding the receiver node it may out of coverage area of sender node then select or find the procedure for routing to traverse in optimal path to send data packets between sender and receiver.

Types of wireless networks: One is peer to peer or Ad-hoc based and another is Infrastructure based. An ad-hoc based wireless networks connected with many computers are provided or installed with a wireless NIC card. Each computer or device provides connectivity directly with other wireless infra equipped devices. But they are not able to use or access the resources of WLAN, In these one of the devices act as a bridging or middleware to the wired LAN. Mobile ad hoc network (MANET) [5,7] an adaptive, self adjusting and automatically configuring ,less infrastructure ,multihop wireless network with unpredictable dynamic topologies according to the needs.

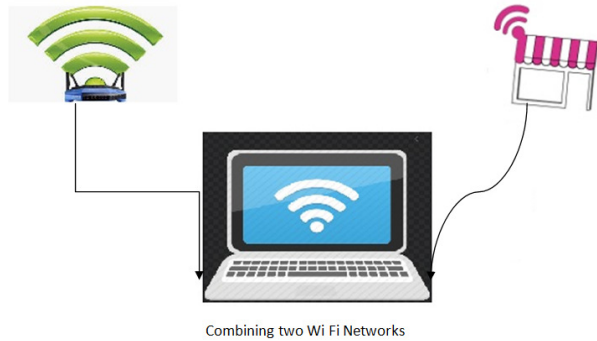


Figure :Combining 2 Wi-Fi Wireless Network Connectivity.

Infrastructure Based Wireless network In these all devices are connected to network with the support of Wireless access point (AP).Access points are usually work like routing device to find the best route to reach the destination which act as bridge between wired LAN and wireless users to convert wireless data into wired data. Mobile Devices moves out of the range of one access point coverage to another access point coverage and maintain the undisturbed network connection. Service Set Identification (SSID) provides 32bit key or name with alphanumeric combination to identify the name of the wireless LAN also called as network name. A wireless device needs to connect to a particular network to communicate with other devices they are configured with the same Service Set Identification (SSID). In wireless Ad-hoc based networks with no AP(access point) it uses Basic Service Set Identification (BSSID) and wireless based Infrastructure network it includes AP(access point) that make use of Extended Service Set Identifier (ESSID)[2,3]. IEEE 802 standards includes two layers of the OSI reference Model in Data Link Layer it holding Logical Link Control(LLC) and Medium Access Control (MAC) .

3.The Research Method

A performance evaluation technique is viewed by combining the wireless network and measures the transmission speed, accuracy and security.

3.1 Method 1:

Combine two or more Wi-Fi Connections at the same time is simple in various latest WindowsOS(Operating System. In Windows Version 10 combining two or more internet connection is possible without using any additional hardware. In old computers does not have any Wi-Fi card then you have to install additional USB Wi-Fi card adapter. Nowadays all computer equipped with single Wi-Fi card connectivity it act as primary connection if need any additional Wi-Fi connectivity install the USB Wi-Fi card adapter to connect to a secondary connection. Once the external card Wi-Fi adapter is plugged into the computer you can able to choose and connect to any one of the available wireless network. Once two Wi-Fi adapters are connected to two separate Wi-Fi networks you are allowed to choose any one based on Enable or Disable properties of available Network connection.

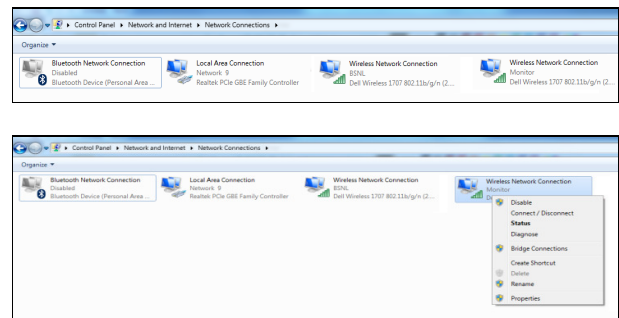


Figure 1: Combining Two Wi-Fi Networks

In the above figure we can able to detect two Wi-Fi Internet Connectivity. Network connections are named as BSNL and Monitor. The System have to select any one of the network connection which provides high speed and security in data transmission.

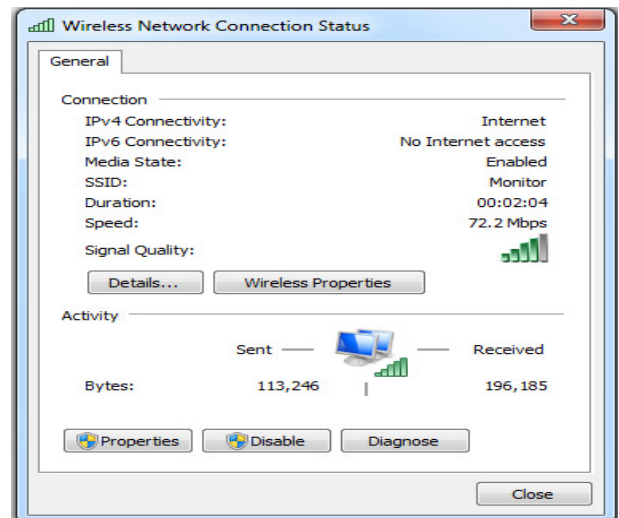


Figure shows the Mobile Network Connectivity Speed

Using the Wireless Network Connection Status parameter speed shows the speed of the wireless connectivity. It shows the version of Internet Protocol used to establish connection its IPV4 is used to connect to the internet network, network name is identified by using the parameter SSID, upload and download speed is read by using the send and received parameters.

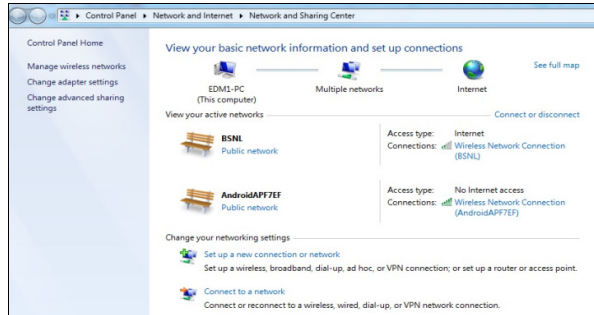


Figure Shows the detection of 2 Wifi Networks

For bridging the two Wi- Fi internet connection in control panel the property Nwtwork and Sharing Centre shows the available Wi- Fi internet connectivity with access type property shows the primary internet connection that currently used as active one the secondary connection access type property shows as no internet connection and connection property[7] shown as connectivity name in above figure it shown as AndroidAPF7EF.

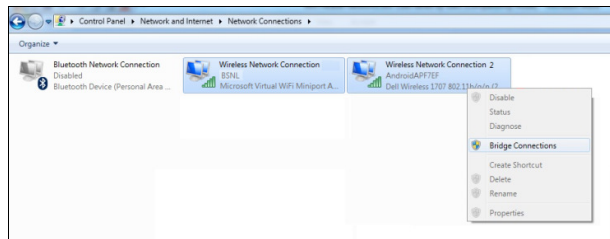


Figure Shows the Bridging of 2 Wireless connectivity

Network connection property detect and shows two wireless network connection with network name select both the networks and right click it popup the menu options that list the bridge connection option as one of the property select and click the bridge connection property to bridge the two Wifi Connection . In OSI reference model bridging is carried out in layer2 is Data Link layer, major types of bridging Simple using the store and forward technique and decide frame by frame basis whether its forwarded from one network to

another network it maintains frame integrity and reduce collisions, Multiport bridging serve as network switch it's also uses store and forward technique and bridging in transparent manner that make use of table namely forwarding information base to maintain the flow of data frames and frame flooding also managed effectively

3.2 Method II:

Load Balancing Technique is used to distribute the available data over the different Wi-Fi Channels. Operating System automatically selects one as primary and other as secondary based on the property Automatic metric's interface metric value. If the interface metric value is low it provides high priority for that Wi-Fi connectivity. Selecting the primary connection based on the Interface metric value .Both the available Wi-Fi networks having the same interface metric value than it uses both the connection simultaneously to transfer data and any type of internet lines will bounded to increase the speed of transfer its possible to aggregate any broadband from ISP to increase the available WAN bandwidth.

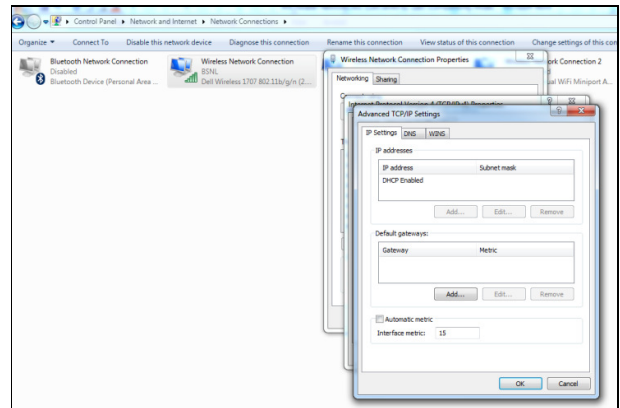


Figure shows the Interface metric value property

3.3 Method III:

Combining 2 Wifi Wireless Connectivity Application (C2WWCA) used to combine two Wi-Fi connection to increase your internet speed and bandwidth. Today most of the computer are equipped with a single Wi-Fi card it act as primary adapter and using Universal Serial Bus(USB) Wi-Fi adapter act as a secondary adapter .After plug in the USB Wi-Fi adapter you are allowed to select any one of the wireless network to connect the internet. The application designed to connect both Wi-Fi networks simultaneously by combining them for faster, secure and reliable internet; It provides the fast mobile virtual private network (VPN) service to enhance the performance of quality and speed.

Application (C2WWCA) provides the unique channel bonding to combine two Wi-Fi internet connection and provides faster and reliable connection. When we try

to combine two or more Wi-Fi internet connection to improve the speed by receiving various connections must come from different internet sources. Application provides a virtual private network (VPN) to focus on speed, security and reliability. VPN provides secure network connectivity between the source and destination through available internet. Application servers hide the IP address of source instead the server handles the request hence it's hard to trace the activity. In a network system request for data it received at the application server end on behalf of source the server index the request and sends across the internet and receive the response and it forward to the actual source. Data file is split thousands of data packets then deliver via the socket of your computers and reassembled by browser at the destination end. A device or source computer connect to application server both are combined to act as client node they function together to find the route in internet traffic to reach destination node. Client application using channel bonding technology to send data packets among multiple available internet connection by split all traffic at data packet level even for file in large size and improve the streaming of uploading and downloading files effectively. Application establishes a connection to server in a cloud. Speed server acts as a middle man between source and internet. Speed server in the cloud intelligently divides the traffic and delivers the combined speed.

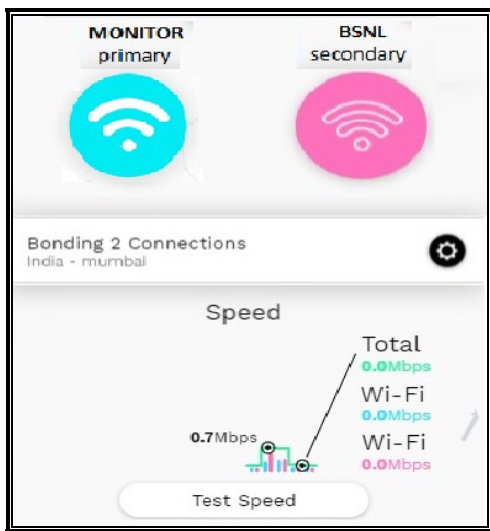


Figure shows the Combining the 2 Wifi networks

Application is a platform independent without Virtual Private Network (VPN) built from the ground up for speed, security, and mobility. It uses the technique called channel bonding to combine the available Wi-Fi internet connections and use encryption standards to increase the performance of conventional VPNs on desktop computers and mobile devices.

Application is a Virtual Private Network (VPN), using AER (Advance Edge Routing) [8]. In such a way VPN designed from the base level to get

improved performance for both the wireless and wired user, when compared to other VPN system. It is improved model of VPN that make use the technique like Channel Bonding to combine the internet connections to provide speed, reliability, and security service .[5].

Security: In VPNs, applications encrypt your data to provide data security during transferring the packets between the two nodes .The people even connected in the same connectivity like Wi-Fi hotspot or ISP, they are not able to find your data or they do not know which sites you are visiting. This application provides encryption to the date on device. Nowadays the devices use the various engines like AES. The associated problem is if the processor not support AES acceleration, then it use the encryption algorithm called ChaCha, to provide secure, fast and improved performance. it will work on older devices like phones.

Bonding: channel bonding technique uses the multi internet connection to increase or improve the throughput. It's possible combine the Wi-Fi mobile data, Bluetooth, and wired network simultaneously to speed up your work. The application interacts with servers and effectively distributes all the data packets in the available internet connections. Channel bonding spread individual data packets among the available multi internet connections. By detect and split traffic at the packet level, it provides streaming data like videos files with improved speed.

Speed: Application Servers in the cloud act as interface between sender device and the rest of the internet. After connecting to one of these Servers, the application works in intellectual manner and divides the internet traffic and delivers the data packet in available connections with improved speed. It shows the site that visited from the hosting servers . Channel bonding provides improved capabilities, if you lose internet connections during data transfer , your transfer will be continued without major interruption .

4 .Analysis of Methods

4.1 Method 1.

Combining two wifi network connection using Bridge Connection properties of network connection and make use of two different network to transfer the data simultaneously between the source and

destination to increase the performance of transfer rate. It make use of store and forward approach technique that operates based on the Management Information Base(MIB) to manage the data frames between the two end points.MIB control the frame movements and update the information base based on the routes of frame. Information base stores the routing information of data frame and finds the path to forward the data frame without flooding. In MIB it stores the source and destination address of nodes and respective routing information the frame in bridge connectivity checks the routing information in the information base[8,9] and accordingly it selects the route based on shortest path and reach the destination.

Management Information Base consist of object identifier and MIB tables. Each table assigned with object Identifier in each module.The Interface Receive Address Table (ifRcvAddressTable) in the MIB list all the addresses used by interface.Each MIB table formed with index(column) and Instance of objects(row) the primary index is interface index (ifindex) and the secondary index is interface receive address (ifRcvAddressAddress) Using the primary and secondary interface we can identify the specific address of a interface.

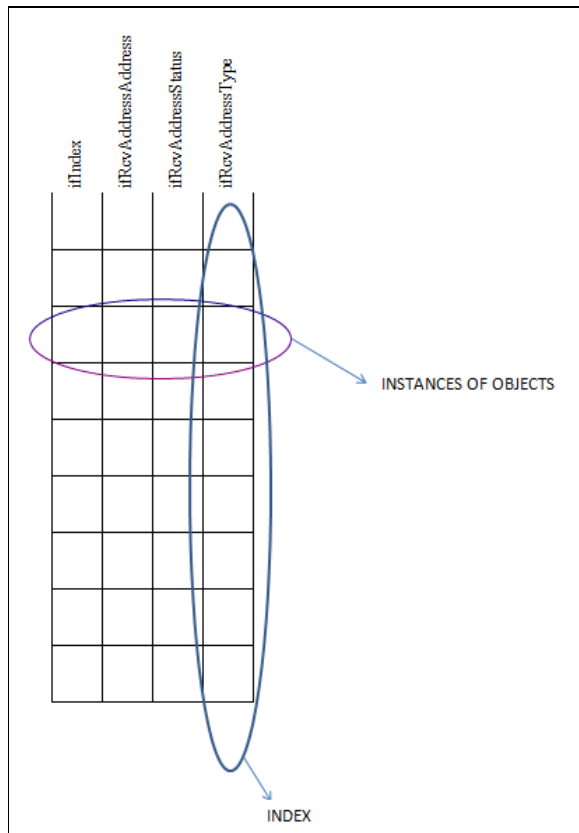


Figure shows Management Information Base

Bridging connection property improves the performance of network to some extent .

4.2 Method II

In Load Balancing Technique the open system interconnection(OSI) reference model for networking

includes two important layers where load balancing is performed they are Application and Transport layer. Application layer operates at the highest level of protocols include HTTP. Its split the load between two or more available networks using different algorithm its implemented at transport layer. It establish multiple connection and they are separated without any interruption .Network adapter assign auto interface metric value according to the connection performance. In real scenario 2 video files from same server is requested then the video file selects a connection from the available multiple connection ,So according to number of file transfer to be made is effectively managed by detecting the available connection and assigning them to provide maximum throughput. Network Bonding or Link aggregation is a different technique whereas the data packets of file to be transferred are send through various path by encapsulating the data at source end ,the same the data packets are decapsulated at the destination end to receive the data file. Network adapter in windows has 2 cost metric values that automatically assigns the value according to the performance of connectivity ,they are interface metric and default gateway metric the network adapter assigns the route metric value based on the interface and default gateway metric values.

A simple way to implement the load balancing technique without additional software is assign a same interface metric value to more than one available connection by disabling the Automatic metric option ,the low metric value connectivity have high priority if both the available connection having same priority then both connection are used for file transfer.

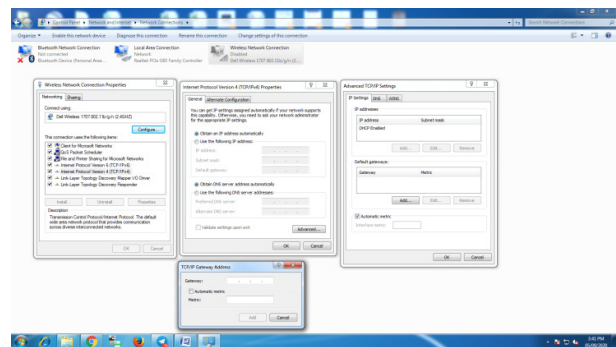


Figure shows Gateway Metric Value Property Box

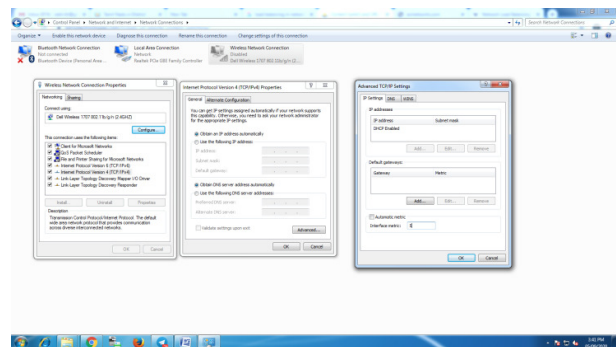


Figure Shows Interface Metric Value Property Box

I manually checked by setting the interface metric value for downloading the 2 files and verify the traffic was going in one network interface for one file and another in another network traffic interface value .

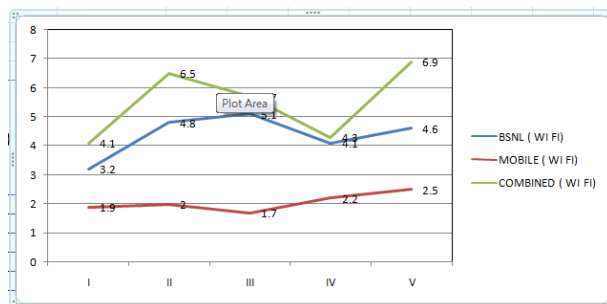
4.3 Method III:

Combining 2 Wifi Wireless Application (C2WWA) is used to combine the 2 Wifi connectivity to increase the speed of the internet . Combining 2 Wifi Wireless Application (C2WWA) combined the two Wifi wireless connectivity to enhance the strength of upload and download speed. The application first detects the available wifi wireless internet signal and then scans each and every connectivity for upload and download speed at a point of time, it varies time to time according to the load and capacity of the hardware that also one of the factor involved in measuring the speed of connectivity. After that combined connectivity strength is measure at a point of time, it indicates the upload and download speed which depends on the scanned connectivity strength.

S.No	Scan for Network Speed at Various Instances	BSNL (WI FI)		MOBILE (WI FI)		COMBINED (WI FI)	
		Download	Upload	Download	Upload	Download	Upload
1	I	4.2 Mbps	3.01 Mbps	1.56 Mbps	1.21 Mbps	5.6 Mbps	4.1 Mbps
2	II	4.45 Mbps	3.15 Mbps	1.21 Mbps	0.92 Mbps	4.7 Mbps	3.5 Mbps
3	III	4.1 Mbps	3.12 Mbps	1.35 Mbps	1.15 Mbps	5.4 Mbps	4.2 Mbps
4	IV	3.85 Mbps	2.98 Mbps	1.11 Mbps	0.88 Mbps	4.2 Mbps	3.2 Mbps
5	V	4.31 Mbps	3.12 Mbps	1.41 Mbps	1.17 Mbps	4.7 Mbps	4.1 Mbps

shows the download and upload speed of networks

S.No	Scan for Network Speed at Various Instances	BSNL (WI FI)	MOBILE (WI FI)	COMBINED (WI FI)
1	I	3.2 Mbps	1.9 Mbps	4.1 Mbps
2	II	4.8 Mbps	2.0 Mbps	6.5 Mbps
3	III	5.1 Mbps	1.7 Mbps	5.7 Mbps
4	IV	4.1 Mbps	2.2 Mbps	4.3 Mbps
5	V	4.6 Mbps	2.5 Mbps	6.9 Mbps



Comparison table for 2 Wifi Wireless and Combined Connectivity.

Through this it observed three different scenarios and one major aspect expected and required is based on the combined connectivity speed is better than the available 2 Wifi wireless connectivity or equal to the speed of available wireless connectivity.

The Edge routing scheme follows KD –Tree (K Dimension Tree)[14,15] do not overlap their sibling nodes. Next remove the overlap node between existing rectangular area in that internal node (i) has two child to split the amount of overlap horizontally is $o_h = \text{rightside}(\text{leftchild}(i)) - \text{leftside}(\text{rightchild}(i)) > 0$ [10,11], next we calculate left child by using the formula $-O_h / 2$ and right child by $O_h / 2$. The time taken for execution to remove overlapping is given as $O(n \log n)$.

5. Algorithm Design

The KD- Tree [12,13] of non intersecting nodes with convex hulls it's possible to construct the visibility graph all the edges between the two nodes . Algorithm route discovery with intermediate nodes between the sourcenode (x) and destinationnode (y) is given below[14].

Algorithm *routediscovery*(X , Y , T)

$X \leftarrow$ the set of nodes of the shortest path between source x and destination y in the KD-Tree

$W \leftarrow$ the lowest common ancestor of x and y

$H \leftarrow \{ \text{hull}(\text{sibling}(i)) \mid i \in U \setminus \{x,y,w\} \}$

return $H \cup \{ \text{hull}(c) \mid c \in \text{children}(x) \cup \text{children}(y) \}$

Bandwidth is the speed of the network able to transfer or forward data packets, physical bandwidth are independent of end nodes that act as hosts. Throughput is the amount of data that is transferred successfully between the end nodes via the network using the available bandwidth. Transmission Control Protocol will be tuned along with hardware and software requirements to find round trip time between end to end nodes, buffer size and other factors can affect throughput[15].

Capacity(C) – Maximum number of bps data can transfer over a network.

Utilization(U) – % of the capacity on a path that currently used.

$$U = \text{Traffic} / C$$

Available Bandwidth (A) is the capacity subtract from cross traffic (utilized) in a given time interval .

$$A (ts_s, te_c) = \text{Capacity} - \text{Traffic}$$

$$= C \times (1 - U)$$

$$\neq A (T_{\text{window}})$$

$$T_{\text{window}} = (ts_s - te_c)$$

ts_s is the measurement started time.
 te_c is the measurement ended time.

After the finding the shortest convex hull path between the two end nodes now try to combine or make use of available routes in the two different connectivity and get the maximum throughput.

Algorithm to combine or select the available connectivity to enhance the performance[6,7] by looking into the following variable

SW1 – Speed of the Wi- Fi Wireless network measured using VPS(Variable Packet Size) algorithm.

SW2 – Speed of the Wi- Fi Wireless network measured using VPS algorithm.

SC – Speed of the Combined network measured using VPS algorithm.

T – Time in milliseconds.

CC – Current Connectivity used to transfer data.

WL – Total Work load in terms of data packet.

W1 – Work Load assigned to Wi-Fi 1 Connectivity for Data Transfer.

W2– Work Load assigned to Wi-Fi 2 Connectivity for Data Transfer.

RW1 – Ratio of work assigned to Wi-Fi 1 Connectivity.

RW2– Ratio of work assigned to Wi-Fi 2 Connectivity.

Algorithm ConnectionFinder(SW1,SW2,SC)

```

while ((T mod 10000) equals 0)
  if(SC < Max(SW1,SW2)) then
    if(SW1 > SW2) then
      CC=choose W1 Wifi
      connectivity to Data Transfer
      W1=WL
    else
      CC= choose W2 Wifi
      connectivity to Data Transfer
      W2=WL
    Endif
  else
    RW1=(SW1/SC)*100
    RW2=(SW2/SC)*100
    W1=(WL*RW1)/100
    W2=(WL*RW2)/100
  Endif

```

Next

return.

The above algorithm find the connection to perform data transfer using Wifi wireless network at the same time in different modes the system have to select either Wifi 1 or Wifi 2 wireless network if the combined speed is less than the Wifi1 or Wifi 2 wireless network otherwise share the Wifi 1 and Wifi 2 wireless networks according to the speed. Measuring the speed of the signal using various tools it concludes that actual combined speed is less than or equal to the available Wifi 1 and Wifi 2 connectivity speed.

6. Conclusion

Combining 2 Wifi Wireless Connectivity Application (C2WWCA) provides the efficient and improvised utilization of bandwidth by combining the available Wifi wireless connectivity. It make use of available channels for downloading and uploading the sequential data packets during comparison, it observed that downloading and uploading speed is almost greater than or equal to the available Wifi wireless connectivity having higher downloading and uploading speed, sometimes it equal to the combined speed of both the Wifi wireless connectivity. In most of the time, it less than the combined strength because of transmission error and dynamic change in the route. The performance was affected because of dynamic change in route and loss of data packets during change in route and variation in speed based on traffic. It shows 40% of times the combined network is utilizing the 95 % of 2 Wifi wireless connectivity speed, 40% of times combined network speed is greater than 80% of combined Wifi network connectivity speed and less than the addition of 2 Wifi wireless connectivity speed and 20% of times Combined network speed is less than 70 % and speed greater than or equal to the higher wifi network connectivity speed.

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