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NOVEL OPTIMIZATION ALGORITHM TO ENHANCING THE PERFORMANCE FOR VOIP AND MDVC VIDEO TRANSMISSION IN WIRELESS MESH NETWORK

M.K. Kishore
Research Scholar, Department of Electronics and Communication Engineering, GIET UNIVERSITY, Gunupur, Odisha, Pin- 756022 & Assistant professor, Department of Electronics and Communication Engineering, Usha Rama College of Engineering and Technology, Telaprolu. Ungutur Mandal, Krishna district, Andhra Pradesh -521109
Mail ID: m.koteswarakishore@giet.edu

Dr.B.Nancharaiah,
Professor & HOD, Department of Electronics and Communication Engineering, Usha Rama College of Engineering and Technology, Telaprolu. Ungutur Mandal, Krishna district, Andhra Pradesh -521109, Mail ID:nanch_bn@yahoo.com

Dr. V. Gajendra Kumar
Associate Professor, Department of Electronics and Communication Engineering, GIET UNIVERSITY, Gunupur, Odisha, Pin-756022, Mail ID:rajigajendra1@gmail.com

Abstract

Due to their spontaneous deployment and reasonably priced implementation, Wireless Mesh Networks (WMN) are seen to be an excellent solution for delivering communication networks in the last mile. Multi-path transmission is a key element of WMNs, which can result in enhanced territory service, enhanced ruggedness, and increased capacity. Multi-path WMNs minimize the need for a large number of wires and can be set up quickly and at a low cost. The globally integrated implementation of Wireless Local Area Networks has enhanced the appeal of broadband wireless technology. VoIP has become a popular Internet application in wireless LAN. Providing great results in video processing, such as VoIP, is a must for upcoming cellular networks. A widespread and interactive video streaming system for Multiple Description Video Coding (MDVC) based video streaming across WMNs to heterogeneous receivers. MDC is a useful method for video broadcasting via erratic pathways due to variable channel quality. A video streaming system for instruction is proposed, which is built on a wireless mesh network. A wireless mesh system is a conscious, subconscious, and sustainable intelligent technology that uses developmental progress to rapidly set up a network. In this system for multimedia transmitting data, internet service is critical. The scalable video coding approach used in this unique system allows the video server to provide layered videos to multiple user groups. The outcomes demonstrated how several variables, including mobility and load, may have an impact on Wi-Fi performance. Mobility is simulation input metrics, and the article's performance metrics included packet delay ratio, throughput, delay jitter, and end-to-end latency.

Keywords: Wireless Mesh Networks (WMN), Packet Delivery, Jitter, Throughput, Collision Detection, Voice over Internet Protocol (VoIP), Multiple Description Video Coding (MDVC).

1. INTRODUCTION

Wireless sensor networks are made up of a horde of embedded devices of varying sizes that are typically very small (nodes). These disposable, low-cost, and low-power sensing nodes must collaborate. They are capable of constructing a large-scale wireless network and can configure themselves automatically once the network is operational. In the design of wireless sensor systems, it is common practice to incorporate sensor nodes capable of self-organization and the formation of multi-hop wireless networks. Because of this, every network possesses its own processing unit [22]. Because the sensor nodes used in wireless sensor networks have a limited transmission range, intermediate nodes serve as relays to send signals to the sink node. The tremendous demand for data and voice capacity across wireless networks, as well as the popularity of wireless connectivity, cannot be overlooked. Multihop WMNs avoid the need for a large number of cables and can be set up quickly and at a low cost. Network capacity is increased in dense multi-hop networks by utilizing multiple radios, channels, and mesh nodes that support multiple channels. In turn, this increases the network's robustness by allowing multiple paths to be available at once. Due to its low cost and ease of use, VoIP over wireless networks is becoming increasingly popular[23]. Wireless mesh networks have recently been touted as a viable option for VoIP services because they are simple to set up and cover a larger area. The biggest challenges, however, are security and performance as shown in figure 1.

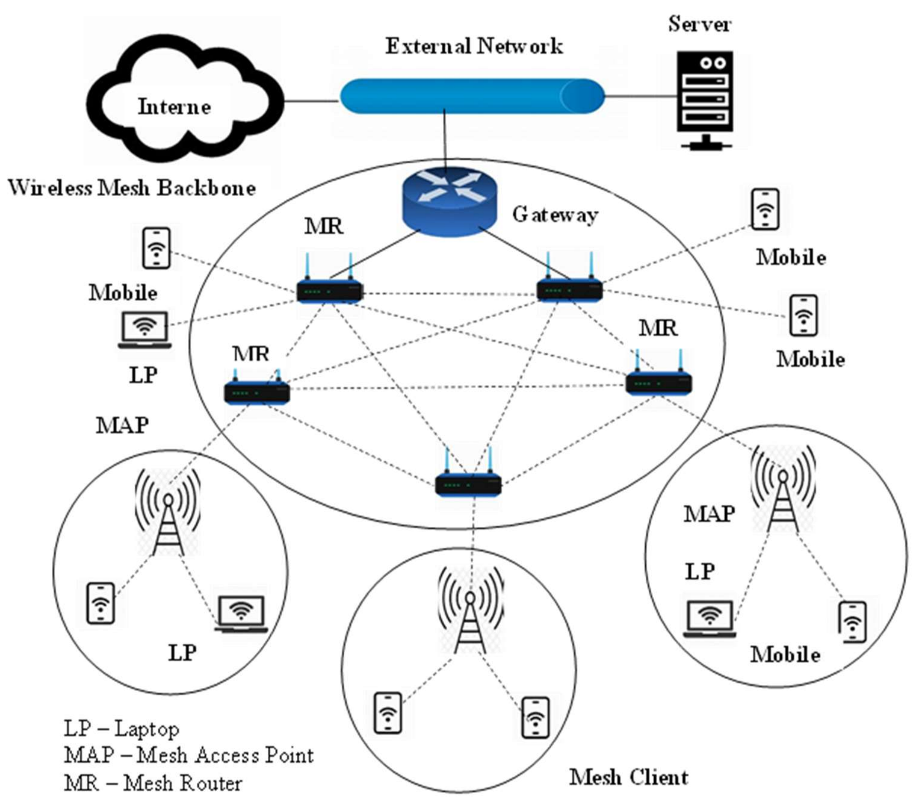

Fig 1: Architecture of Wireless Mesh Network

Regardless of the size of the network, voice over Internet Protocol (VoIP) service running over IP networks has quickly become the most desired service available over wired and infrastructure-based wireless networks. Fixed equipment such as VoIP phones, switches, access points, and routers are examples of devices capable of supporting VoIP services and ensuring the quality of VoIP calls [24]. In most cases, this improved quality is achieved by configuring the routing policies, traffic engineering, traffic shaping, and QoS features on infrastructure devices or networking equipment. These configurations aim to reduce the number of hops, latency, jitter, and packet loss that occur along the path. Alternately, in the event that the networks in question are rendered inoperable as a result of a natural or artificial disaster, the infrastructure that supports VoIP will also be rendered inoperable. Voice over Internet Protocol, also known as VoIP, will become an absolutely necessary service for multihop wireless metropolitan networks in the future of the wireless Internet.

On the other hand, establishing a VoIP service in a wireless mesh network (WMN) that consists of multiple hops and has a large coverage area can be challenging. Packet loss and increased delay as a result of interference can significantly impact the quality of VOIP calls from beginning to end when they occur in a network that consists of multiple hops. When there is a significant amount of traffic, there is a significant amount of medium conflict, leading to a greater packet loss than when there is only a single hop between deployments [25]. In this instance, calls were made from an IP phone to a laptop that contained a SIP softphone. The calls were received on the laptop. Wireshark was utilized to investigate the incoming packets from the client's point of view. Channel access, multiple access, and addressing are the three main functions offered by MAC. Controlling media access effectively (MAC) is required to share the limited bandwidth available.

Furthermore, a quality control mechanism was created to modify the output data rate manually according to network conditions. The suggested techniques are ideal, depending on the specific underlying concepts and findings. Because the network's capacity is increased by using multi-radio multichannel multichannel mesh nodes in dense multi-hop networks, several channels may become accessible, increasing the channel's reliability. In this article [26], we investigate the implications of mobility brought about by Bluetooth, Wi-Fi, and Wi-Max. Bluetooth is an open wireless standard that allows quick data transmission between fixed and mobile devices. In [27], we describe and analyze some practical optimization approaches to increase network capacity while preserving VoIP quality and efficiently managing user mobility. The findings revealed how many parameters, such as pressure and migration, could influence Wi-Fi effectiveness. End-to-end latency, average packet rate, latency oscillation, and transmission rate were used as performance measurements in this work, with mobility as the simulation input variable.

2. RELATED WORKS

Mesh Consumers and Mesh Adapters (MRs) for the Mesh Aspects operate with no resource - constrained devices and most have limited movement. Wireless Mesh Networks have static mesh access points that treat clients as end devices [1]. These are some of the properties of Wireless Mesh Networks (WMN) is multi-hop wireless networks (MWN). It is a data service comprised of active nodes organised in a distributed system [2]. Voice over

Internet Protocol (VoIP) is indeed an Internet Protocol that is used to send multimedia data packets throughout a network. It entails the modernization of voice streams [12]. Gateways and mesh routers form the network's structural framework, where accessibility is limited. It employs a proactive as well as a reactive routing structure [17]. As technology becomes more widely known, a global market for frequency band for voice and data services via wireless networks cannot be rejected [4]. The wireless mesh structure is proposed which use all of the above rules and procedures as well as the resulting connectivity, jitter, power, and lag are determined by calculating [3]. Furthermore, the VoIP capacity tests show that traffic pattern implementation has a significant impact on VoIP capacity results [13]. Initiatives for packet reordering and early drop that help to reduce typical packet delay. Communities have utilized mesh networks, businesses usually are auctioning retail mesh networking solutions, and much studies have focused in laboratory and colleges [5]. The system is constructed also with AODV, DSDV, DSR, and AOMDV methods, and the functioning of one of them is evaluated by using NS2 simulator [14]. Within a week of implementing the WMN, the controller must evaluate its adaptability. The survey's voice packet specifications are critical, as they open the way to voice depletion [15]. Each sensor node in a network contributes to an increase in the overall efficiency of the data delivery process, which ultimately results in arriving at the sink node. Moreover, on the other hand, despite being connected to the end nodes, all of the nodes close to the sink node experienced a minimal increase in the packet delivery overhead [6]. This was the case even though they were connected to the end nodes. The application known as the NS2 simulator served as the basis for the research that was conducted into the performance of Bluetooth, Wi-Fi, and WiMax. Both wired and wireless networks can benefit from the functionality, which is advantageous. On the other hand, evidence can occasionally be obtained through simulation in real-world settings [7]. When the traffic load is increased to 7 packets per second, the packet delivery ratio can drop by as much as 30 percent, which is an important fact to keep in mind [16].

3. PROPOSED SYSTEM

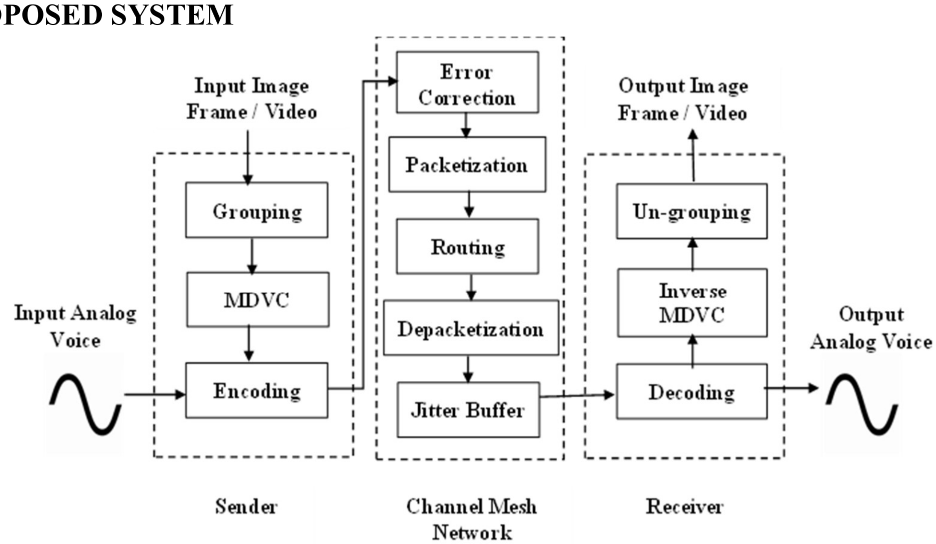

Fig 2: System model for voice and video transmission

Figure 2 shows our proposed framework for error resilience for this research. MDC and multipath routing are the foundations upon which it stands. The process of sending an image or video has three components: the transmitter, the channel, and the receiver. All three are necessary for successful transmission. These components all play an essential role in the operation of the transmission. When an image or video is sent through a transmitter, it is fragmented into groups of pixels with the least spatial correlation possible between them. After that, MDC transformations are carried out in a solitary fashion on each set. Before being sent through the mesh network, the data is given a code to protect it[11]. The sending of data packets comes after the process of error correction has been completed. This is done in order to do least partially make up for the losses that are incurred as a result of making use of practical channels. Because each node in a mesh network is connected, either directly or indirectly, to each other node in the network, multiple paths can be taken to travel from one node to another. Therefore, routing is the process of selecting the path that will be the most effective in terms of minimizing the amount of data that will be lost and minimizing the amount of time that will be spent waiting. It is possible to retrieve images or videos transmitted after inverse transforms have been utilized at the receiving end of the transmission to decode the data packets. After completing this step, the pixels will be divided up and repositioned to where they were initially intended to be. After that, the photograph or the video can be viewed[18].

3.1 VOICE OVER INTERNET PROTOCOL (VOIP)

VoIP creation in multi-hop wireless WMNs is especially complex for the eventual broadband networks. When deployed via a multi-hop wireless mesh network, however, VoIP customers experience significant issues. In a multi-hop routing network, packet drop and additional duration due to interference can dramatically reduce the end-to-end VoIP connection speed [20]. When there is a huge amount, there is a considerable amount of intermediate conflict, which allows for increased network congestion rates than with homogeneous network deployment. This difficulty is accentuated by the probability of hiding nodes. Consequently, micro (voice) signal propagation has a large MAC layer overhead. As the description shows, orthogonal frequency division multiplexing, and responding are the three main functions offered by MAC. To share the limited network capacity, appropriate media access control is required. In places where network carriers exist, VoIP consumption is on the rise [19].

3.2 VIDEO ON DEMAND (VOD)

Video on Demand, permits users to watch Miniseries, movie, and another streaming video at the pleasure. Its primary importance is based on the reality that your users may now instantly selected entertainment from a collection of information and stream this through an online environment. Video on demand, also known as VOD, enables users to watch videos without requiring a conventional video player or adhering to an established programming schedule. Most cable and telephone television companies offer video-on-demand (VOD) streaming, in which a user selects a video content that begins broadcasting quickly or uploads to a Recorder purchased or purchased from the supplier and recorded on a Personal computer or handheld device for eventual watching and can be viewed[21].

3.3 MULTIPLE DESCRIPTION VIDEO CODING (MDVC)

Multiple Description Video Coding (MDVC) is a blunder transcription approach for managing transmission errors on communication lines. In MDVC, the video is split into many streams (also known as descriptions), each of which can be decoded and refined independently. If one of the streams is successfully received at the receiver, it can be translated to include a degraded but satisfactory resolution as shown in figure 3. Otherwise, if many streams are received, they are merged to improve video quality. The video will be available to the receivers unless all of the channels break at the same time, which is less common than a single channel failure. As a consequence, MDVC can be used in conjunction with cross-broadcasting to offset highly compressed and unpredictable communications.

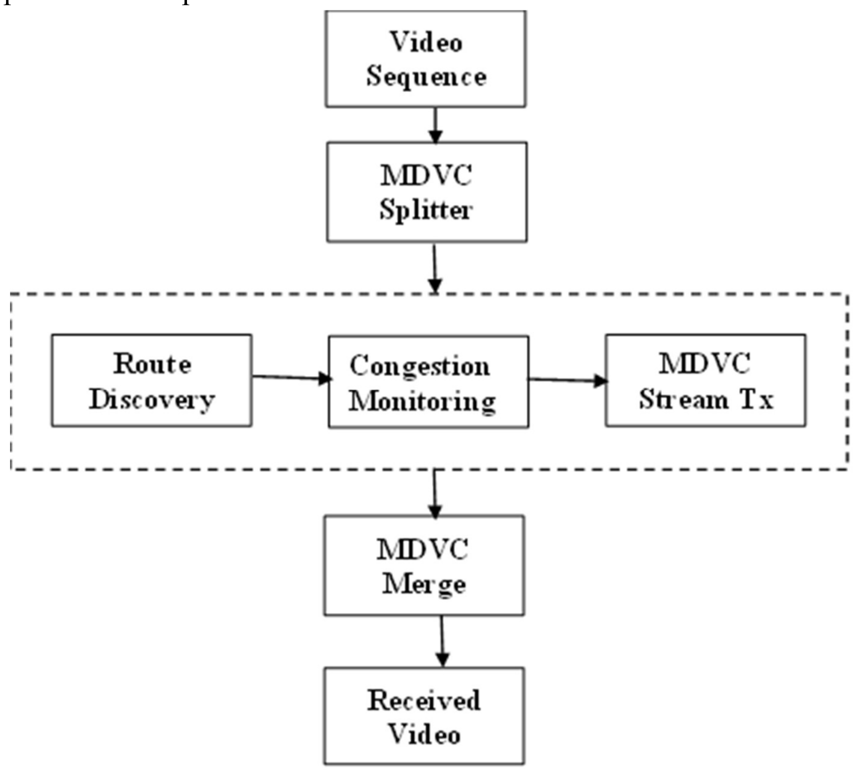

Fig 3: Multiple Description Video Coding (MDVC) Steps for video transmission

3.4 MULTIPLE DESCRIPTION VIDEO CODING (MDVC) ALGORITHM

This section describes how to encode and transmit video using a multiple description coding algorithms over a multipath wireless mesh network. Packets received from the cards may be labelled to indicate whether or not they are voice packets and, as a result, need to be routed through a mesh network. This labelling will depend on the configuration of the router. You can label the traffic that is generated locally at the node if you want to test out this functionality. The utilization of a packet aggregation service makes it possible to support VoIP traffic. This service sends the combined packet on to the subsequent recipient after first encapsulating multiple VoIP packets into a single one. Every interface that we make available is supported by its dedicated aggregator.

On the other hand, a deaggregator is able to take an aggregated VoIP packet and separate it into the original individual VoIP packets that it originally contained. To be switched, a packet must first be routed, and to be sent to a local machine, and it must first be routed (best effort, signaling). Additionally, if a packet is to be switched, it must be routed first before it can be switched (best effort, signaling). Likewise, if a packet should be switched, it must be routed (best effort, signaling) (voice). After the decapsulation of the aggregated packets, the remaining packets are delivered to the classifier so that they can undergo additional processing.

Procedure MDVCVideoChannel(V)
Input: Extract Image Frames from video Vi;
SV_1, SV_2=SplitVideo();
for i = 0 to end in SV_1 and SV_2 do
    F1, F2, F3, F4 = MDVC Frame (SV_1(i));
    F5, F6, F7, F8 = MDVC Frame (SV_2(i));
    Multipath Routing (F1, F2, F3, F4, F5, F6, F7, F8);
    MDVC Stream Tx
    Merge MDVC Image Frame Sequentially;
end for
Output: Inverse MDVC Image Frame

4. SIMULATION RESULTS AND ANALYSIS:

The speech traces employed in our simulated investigation are identical to its use in the experimental result. We note that our speech channels' talk-spurt lengths (8 voice streams for 5 discussions) cannot be adequately described as exponential ranges. The exponentiality for 55% of voice traces is rejected at the 75% confidence level using the Johnson exponentiality analysis.

Table 1 shows the typical MAC parameter values that were used in this study, and those values were compared to these results in order to determine the Packet Delivery Ratio (PDR), Jitter Distribution Statistics (JDS), Average End to End Delay (AEED), Packet Collision Ratio (PCR), and Delay Time (DT).

Table 1: Parameters for Simulation

Parameter	Wifi	Wifi-Max	Bluetooth	Description
Traffic model	continuous	continuous	continuous	CBR is used
Number of nodes	change	change	change	No of participant in network
Node placement	Invariable	Invariable	Invariable	Node placement policy
Mobility	4-90(m/s)	4-90(m/s)	4-90(m/s)	Node moving with its speed
Simulation time	8s	8s	8s	Maximum execution time
Power	80	20	30	These are the powers used
Terrian dimension	1800,1800	1800,180,0	1800,180,0	Phy. area the nodes are placed
Radio frequency	38 eq	38 eq	38 eq	These are the frequencies used.
Routing protocol	aodv	aodv	aodv	These are the protocols used in routing
Mac protocol	1500ns	NA	NA	Delay in propogation

Bandwidth	3000000	1500000	1100000	These are the bandwidth used
MAC propagation	801.3	803.1	803.12	These are the propogation used

4.1 Scenario 1 - Packet delivery ratio:

The most critical measure to consider in forwarding the packets is PDR. PDR is ratio of the total number of packets received divided by the total number of packets sent in percentage. Only backward path traffic is taken into account in this statistic as shown in figure 4. Different criteria, such as incoming packets, team balance, action range, and node mobility, may have impact parameter values are given in Table 2. Different factors, including group size, packet size, node mobility, and action range may have an impact.

Table 2: Packet Delivery Ratio

Mobility	Total packet sent	Received by Wi-Max	Received by Wifi	Received by Bluetooth
5	4986	4986	1123	510
10	4986	4986	1356	800
15	4986	4986	1425	954
20	4986	4986	1770	1290
25	4986	4986	1958	1601
30	4986	4986	2376	1900
35	4986	4986	2500	2000
45	4986	4986	3187	3003

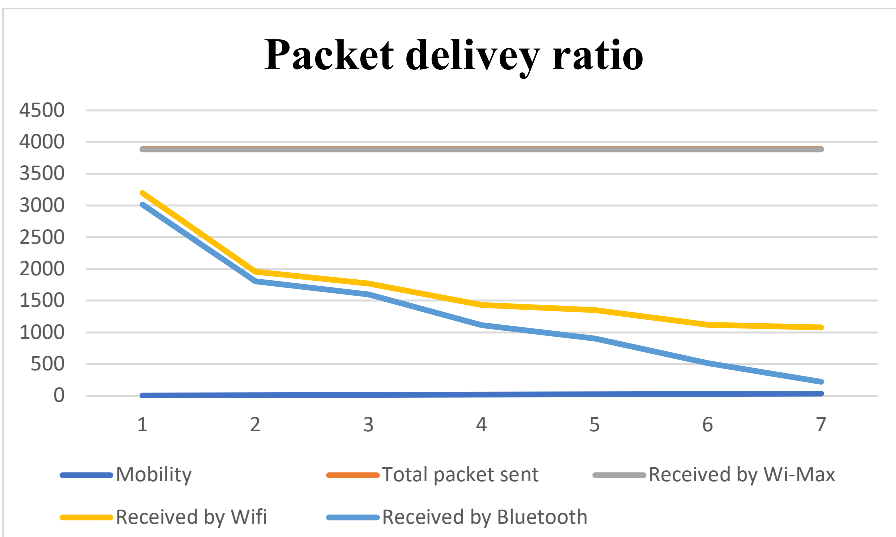

Fig 4: Packet Delivery Ratio

4.2 Scenario 2 - Jitter Distribution statistics

The distributed filtering limitation can be overcome for a class of precisely defined dynamic simulations over a network system with a learning form, sensitive to underhandedness attacks launched by opponents, which can win or lose at unexpected times with a known frequency, which is not inherently the same for sensing devices parameter values are given in Table 3. The systemic approach integrates certain unexpected imperfections and characteristics that are applicable in practice in interconnected networks. A distributed filtering mechanism is used over a problematic environment with decaying observations susceptible to deception threats as shown in figure 5.

Table 3: Jitter Distribution statistics

Mobility	Total no of packet sent	Wi-Max	Wifi	Bluetoo th
5	10	7	2	9
10	20	12	3	11
15	30	19	3	19
20	40	21	3	21
25	50	32	4	26
30	60	49	4	31
35	70	54	5	39
40	80	78	8	41

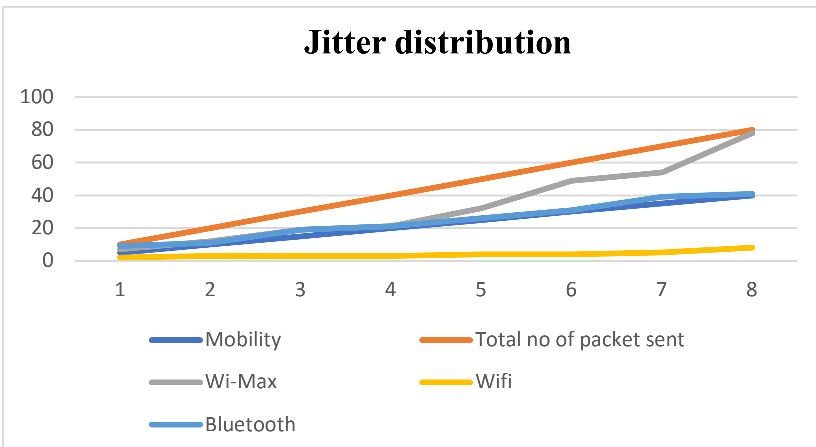

Fig 5: Jitter Distribution statistics

4.3 Scenario 3 - Average End to End Delay

The overall latency encountered by a packet while traveling across the network from transmitter to receiver is known as the delay. The total of the network topology's final packet delays. delay in sequencing, choice of distribution, and communication as shown in figure 6. Delay in queuing and propagation the entire process from beginning to conclusion is referred to as the "final process." The sum of the delays at each node determines the path's total delay. Node-to-node delay and parameter values for each link are shown in Table 4.

Table 4: Average End to End Delay

Mobility	Total package sent	Wi-Max	Wifi	Bluetooth
5	0	0.005236	0.021	0.02
10	0.02	0.005345	0.02087	0.0203

15	0.04	0.005267	0.001983	0.001974
20	0.06	0.005325	0.0019245	0.00191
25	0.08	0.005328	0.001834	0.001821
30	0.1	0.005432	0.00181	0.001802
35	0.15	0.005328	0.001732	0.001721
40	0.16	0.005329	0.001729	0.001702
45	0.17	0.005328	0.001643	0.001623

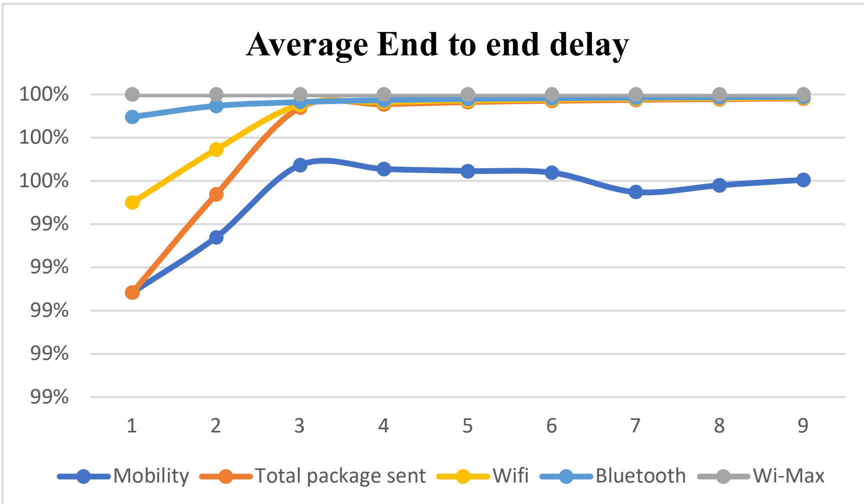

Fig 6: Average End to End Delay

4.4 Scenario 4 - Packet collision ratio

A "packet collision" is the phenomenon that occurs in a network when two or more packets traveling from different source nodes simultaneously arrive at the same destination node. This can happen when two or more packets travel from the same source node to the same destination node. The sum of the individual packets is equal to the total number of packets that make it to a given location. This demonstrates the total number of packets that are seen by a particular node, which can be found in Table 5, which also contains the parameter values. The packet collision ratio is the percentage of the total number of lost packets due to collisions with other packets. This ratio is expressed as a percentage of the total number of packets. The percentage of data packets that are lost at a particular time-end node as a result of an error such as a collision or corruption is referred to as the packet loss rate. It is significant in some way. Taking into account the total quantity of packets (collided packets plus corrupted packets). As can be seen in figure 7, the graph demonstrates that the number of collisions positively affects the performance of Wi-Fi.

Table 5: Packet Collision Ratio

Mobility	Wifi	Wi-Max	Bluetooth
15	45	6	57
20	37	4	46
25	29	3	39

35	21	3	24
55	19	2	18
60	13	2	11

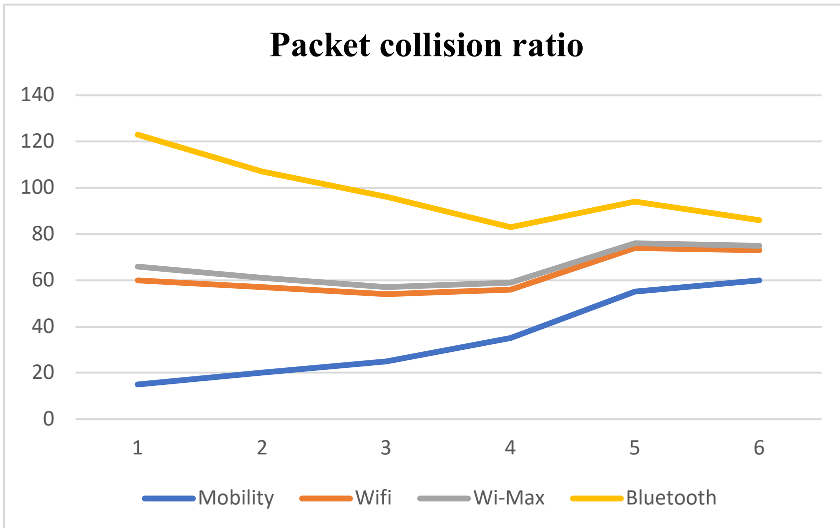

Fig 7: Packet Collision Ratio

4.5 Scenario 5 - Packet throughput

In other words, it tells how many bits per second are being sent back and forth. The matrix shows the superiority of technology. It is either the best or not the best due to the matrix because the technology has the highest performance with the highest throughput. It could be intake or exit performance, but output bandwidth is most commonly calculated by measuring the effectiveness parameter values are given in Table 6. Wi-MAX is a high-speed wireless network. Wi-Fi technology has a lesser impact as shown in figure 8.

Table 6: Packet throughput

Mobility	**Total no of packet sent**	**Wi-Max**	**Wifi**	**Bluetooth**
5	10	25	2	11
10	20	29	3	18
15	30	32	3	21
20	40	49	5	29
25	50	51	5	38
30	60	59	6	41
35	70	60	7	52

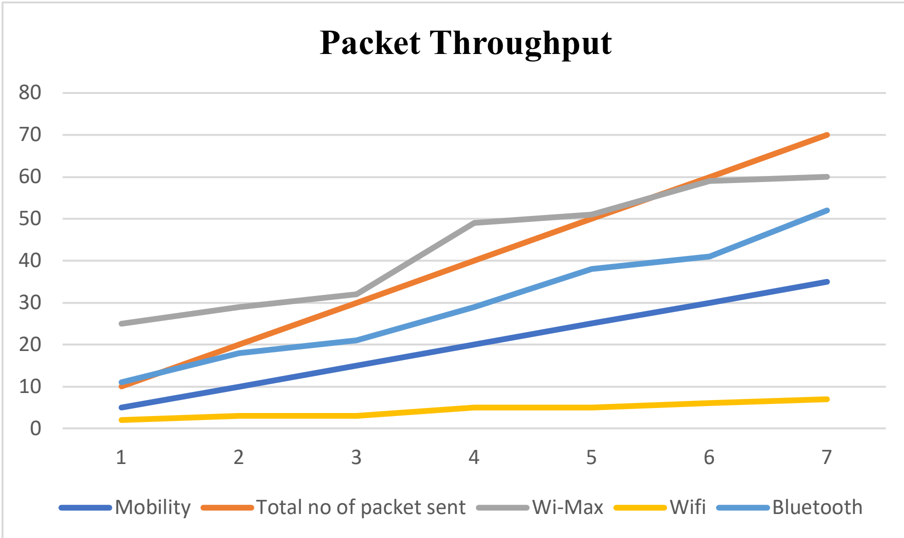

Fig 8: Packet throughput

5. Conclusion

This paper has provided a detailed analysis of the most significant evolving wireless access networks, as well as a description of how these innovations might be linked to provide last-mile technologies. The WI-MAX specification has been demonstrated to be the optimum, but it is not expected to replace Wi-Fi or Bluetooth. We've displayed and analyzed the behavior of individual WSN network typologies that can be used in operational industrial applications. Our main contribution is to propose and examine technologies that are fundamental for implementing VoIP and Video on demand based on researching numerous design options and bringing the proposed optimization techniques to the test.

The investigation of VoIP and video efficiency in WMNs has indeed been approached realistically in this work. The approach has two benefits: 1) it allows for the research to use more reflective speech data and image frames that will be sent via networks, and 2) it provides a better depiction of voice data traffic than predictive methods and other image frame simulations. The VoIP capacity testing yield encouraging outcomes for VoIP implementation in WMNs. Additionally, the Tests of VoIP's and VoD bandwidth demonstrate that the localisation of the travel patterns are crucial role in the VoIP capability outcomes. Based on our findings, the voice and video capacity decreases, when the amount of increases dramatically by much more than 65% grows from 3 - 5 hops. The VoIP capacity tests suggest that VoIP and VoD implementation in WMNs can be successful. VoIP research also found that traffic pattern specialization significantly impacts VoIP's high level. If traffic patterns in an integrated scenario are more specialised than those in a stand-alone scenario, then an integrated scenario will have a higher capacity for VoD.

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