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Development of Recovery and Redundancy Model for Real Time Wireless Networks

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ABSTRACT

It is becoming clearer that dependable communication via wireless networks is a need as the number of uses for wireless technology grows. The challenges of ensuring punctual transmission through a wireless mean a major difficulty because of its erratic delivery. Here, we provide a Sequential time division multiple redundancy and recovery wireless communication, space-time division multiple-access (S-TDMA) is created. Those in the press Station selection is handled by the S-TDMA medium access control (MAC) layer. Should broadcast within a certain window of time determined by the channel's current status. MATLAB was used to run simulations of the modeled systems. The SIMULINK application. Signal processing and control blocks in SIMULINK the telecommunications infrastructure was modeled using communication block sets. Total link reliability, system throughput, and error rate are used to assess S-performance. TDMA's production rate, typical percentage of on-time deliveries, and the delay caused by the system. Analyses, when contrasted through graphs, reveal recovery times with immediate retry and loss of frame were determined to be respectable dropped data signals.

Introduction

Verifying uninterrupted real-time delivery in a wire-free communication channel is difficult. When compared to wired networks, its dependability in delivering data is low [1]. Real-time applications in

Wireless broadcasting place severe a limited window for transmission, which makes packet loss quite frustrating. harder to cover [2] When two people are able to talk to one other in use case that must have guaranteed service levels (Quos) pertaining to the communication network, such as the longest possible latency, maximum allowable loss at its interface to ensure level of service that was desired [3] The continuous monitoring of a network's capacity to transmit data over a certain amount of time limit. What this means is that data in real time must be re to the intended recipient before a specified time limit [4]. Some highlights of the real-time applications

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covered in Al-Kuwaiti [5] are timeliness, peak load design, productivity capacity, tolerance for failure, and ease of upkeep To address the problem of medium congestion, the time division multiple access (TDMA) technique has proven effective. And frame collisions, but frame reception persists unexpected because of the interconnected and evolving character of the system. Medium-specific [1]. With TDMA, a real-time MAC protocol may be created. In order to provide stations a way to schedule a Trans slot for a specific mission inside the TDMA network's cycle. That's why the math Consideration must be given to the amount of time necessary for transmission. Figure out how many tries at sending will likely be needed In order to reach a certain degree of dependability. Due of the collaborative nature of wireless technology, enable noise in the environment. Common methods for combating such intrusion include protocol implementations like Time Division Multiple Access the term "media access control" (MAC) refers to a (MAC) Multiple Access with Collision Detection Protocols and Carrier Sense Multiple Access multiple access with collision avoidance (CSMA/CA) (Multi-Agent Crash Avoidance) (MACA) are more likely to be involved in conflicts and accidents. This is because there are a variety of entrance points to the Me simultaneously [6] Therefore, TDMA is an appropriate protocol for channel access approach offers a medium devoid of collisions and arguments background noise causes transmission problems. Disturbances, temporary propagation effects, etc. Errors in a burst defined by a pattern of occurrence and dispersion, frame losses are recognized when burst duration is reduced [1, 7]. We can't prevent frame drops on wireless networks, so we have to accept that they'll always happen. It's crucial that covert operations succeed. The instant when a burst mistake occurs caused the station to lose a frame or frames, the Each damaged frame must be resent in such a manner that matting does not cause any noticeable degradation in the signal avoid its recurrence as much as possible, and decrease frame-rate effects on other destinations.

Related Works

Achieving redundancy and fault tolerance in real-time wireless Gleeson and Weber [1] investigated TDMA. Concerning the timely arrival of messages, this study looks at technologies for instantaneous wireless communication, plus, Protocol for Probabilistic Admissions Control Provision Some hybrid methods were utilized to ensure the success of packets are always delivered promptly and in real time. This is what the use of a back off exponential function with admissions quotas. Admission the reserve of transmission time ensured by the control assures that When an exponential growth rate is maintained, rebroadcasts may be A faulty transmission was delayed because to the back off mechanism on according to the needs of each individual stop. In this way, the approach guarantees that the in-the-moment was ensured, even while some loss of frames was tolerated. In their paper, Ali et al. [11] introduced a distortion-based slice level prior. Priority for real-time video transmission over wireless networks with Quality of Service networks. In our study, we found that when we prioritized while using encrypted data to get access to the wireless network, a great progress in quality was made because to focus of rejected for use as intended.

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Independent redundancy control for high availability video data transfer utilizing a packet-forwarding protocol wireless networks, error-correcting (FEC) codes are used. By Shih et al. [12] developed a network model. Packet-level the redundant system's self-regulation was implemented via FEC. in order to facilitate wireless high-definition video transmission networks. The suggested method secures live video broadcasts. Protection against wireless losses and regulation of redundancy extent necessary to mitigate the deleterious impact of FEC efficiency. Researchers Basses et al. [13] investigated the protective role of packet impairments in peak signal-to-noise ratios for online video streaming measurement of picture-to-signal-to-noise (PSNR) in videos. Broadcasting video in real time over the web is bandwidth, jitter, and packet losses make it difficult to communicate.

The work use peak signal-to-noise ratio as a measure of video quality to moderate lag while watching a live video broadcast. The Using frame rate compression, the video's findings were In other words, a greater PSNR indicates less data loss and hence higher quality video.

In their research on wireless sensor networks, Wang et al. [14] focused on a hybrid recovery technique based on random terrain (HRSRT). Data collecting and agriculture are two areas that have been identified as requiring more effort to achieve fruition. The primary objective of the vast wireless uses of sensor networks but connection loss in a data collection might fail if the network goes down. Produced in this using High Resolution Surface Reconstruction (HRSRT) that accounts for Take the quantitative constraints of relay devices this study demonstrated the efficacy of HRSRT via simulation. Superior in regards to the total cost of electricity. Redundancy modules cloud computing for reliable IP multimedia subsystem (IMS) the topic of nests by Raza et al. [15]. The IMS is a new a system for communicating that offers a variety of including communication between devices, multimedia content, and streaming services like video over LTE, and more aggressive gaming on a live LTE network. As a result of the new network providers are increasingly recognizing the importance of application using cloud-based IMS and implementing it to accommodate demand for multimedia traffic is rising. What this study found that IMS on the cloud cannot provide session-level resiliency endurance in the face of wrongdoing. This issue has its roots in the ineffectiveness of the systems for bouncing back from setbacks. To help with it is for this reason that the processes on the control plane of the IMS have been designed to be fault-tolerant. A suggestion was made. The results demonstrated that session-level by using fail-over procedures, resilience may be attained. Timescales of milliseconds or less under varying conditions issues with the control plane used by the IMS system. Hybrid cross-layer data with fault-resilient energy efficiency sending data for sensor networks submerged in water was worked on by Vidyalakshmi et al. [16]. One such answer is presented in High packet delivery ratios at low entropy are guaranteed by this study.

Using up a lot of ergs. The results of the experiments show that This new work is superior than previous efforts because The proportion of successfully delivered packets, expected lifetime, and net task that requires you to reach up and grab something. The

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packet was analyzed by Arefi and Khabbazian [2]. Real-Time Loss Recoverable Broadcasting Wireless network densities that are very high. Within the scope of this study, we implement a random a kind of instantaneously decodable network coding (RIDNC) method of instantaneously decipherable networks based on random encoding (Implicative Dual-N-Code) coding, often known as random IDNC encoder (RACE) (RACE). There was a noticeable difference between when simulating with the CrowdWiFi encoder, recovers far more data was lost. Real-time data recovery was introduced by He and Zhou [17] in spatial-temporal wireless sensor networks (WSN) sparse representation based correlation. Relative to the past, Using a combination of low-rank constraints and temporal stability a source of information for analyzing temporal and spatial relationships. To run the simulation again the suggested approach was shown to be superior to the compressed combined CS and matrix completion approach, and CS with a sparse sensing matrix.

Design of the S-TDMA System Model

In this research, a sequential time division multiple access (S-TDMA) wireless communication recovery and redundancy model is developed. For S-TDMA, it's the media access control layer that makes the call. Which Station Deserves Permission to Broadcast at Its Designated Time? Time window determined on the station's current channel status. The Figure 1 depicts a sample S-TDMA time slot system for 6 stations. A time window for transmission is allotted to each station in Figure 1. What is a slot?

A combined frame consisting of the beacon frame (BC), any data, and the differing sized frames and retransmission frames mission if they don't pick it up right away. With the aid of the beacon, separate the super frame and its transmitter from the rest. When using S-TDMA, there is a predetermined amount of time for each time slot in the cycle. Station is free to broadcast at any free time window. The the developed S-TDMA model's flowchart is shown in. Diagram 2

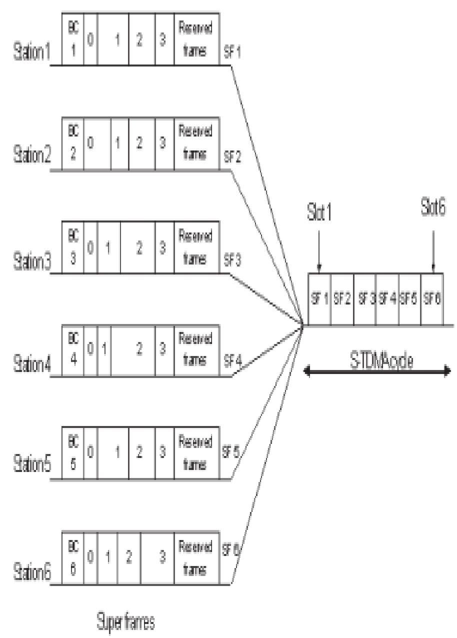

Figure 1. S-TDMA Time Slot Scheme in MAC Layer

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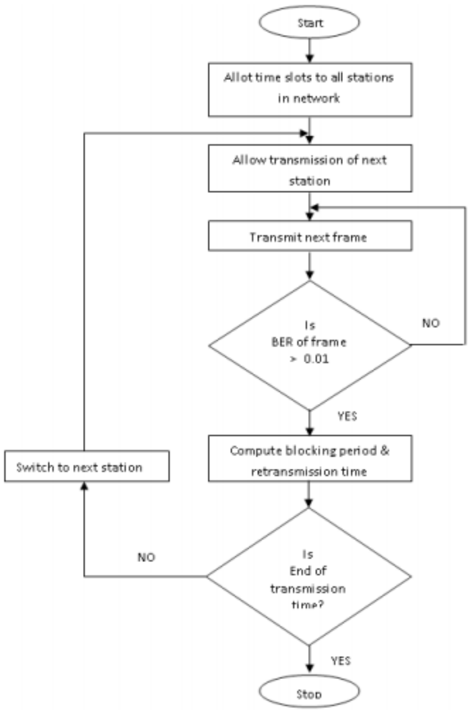

Figure 2. Flowchart of the designed S-TDMA

Performance Metric analysis

Total link reliability (TLR), throughput (), and average probability of proper decoding were used to evaluate the developed S-TDMA model's performance. Delivery on time () and delay in processing (L). These In this part, we define metrics and explain how they may Assess the system's QoS to see how well it meets user needs.

Reliability of All Links (TLR)

In order to evaluate the effectiveness of data collection efforts, we need a metric for link dependability. Communications in a wireless network's broadcasts. A reliable wife connection assures data integrity. The source's sent data was received without error at to throw in the garbage disposal without losing any information. A frame transmission from a station is assumed, thus if the sum of all frames that were successfully sent is An Example of an Equation

$$F_{succ}(n) = \sum_i n_i \quad (1$$

Per station, hence the likelihood that certain frames will be successfully sent is where loss of frames during transmission is achieved in Equation (2):

$$p_{loss}(n) = \frac{\{F_{rq} - F_{succ}(n)\}}{F_{rq}} \quad (2)$$

Where is the chance of having a frame disappear and to send the needed amount of frames, successfully? The Total Link Rate of a Wireless Network Equals: reliability of each station's connection to the network hence, the overall network link dependability is under the pressure of Equation (3)

$$TLR = \frac{1}{N}\sum_{n=1}^{N} LR(n) \times 100\% \quad (3)$$

$$LR(n) = 1 - p_{loss}(n) \quad (4$$

System throughput

System throughput is defined as the rate of transmission of data packets by the system. It depends on the number of data successfully transmitted within a given period of time, and it is measured in megabits per second (Mbps). The system throughput is expressed in Equation (5):

$$\tau = \frac{\text{total packets successfully tramsmitted}}{\text{Maximun transmission time}} \quad (5)$$

Average probability of correct delivery before deadline

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The Health Returns In the event that a frame is not properly received by the sending station, the MAC protocol will ask for a retransmission at a later time. The station may not be able to receive this broadcast. Continue to successfully retransmit until that time has passed. End-of-air-show deadline by station Probability of successfully delivered frames before using Equation (6) as an expression:

$$p_d(n) = \frac{1}{R}\sum_i \left[1 - p_f(i)\right] \qquad (6)$$

$$p_f(i) = P_e(i)^{(R-1)+1} \qquad (7)$$

The retransmission rate and the BER measure the likelihood of a mistake. Accordingly, while taking into account all the nodes in the network job, the typical chance of on-time delivery prior Date of Expression of Equation (8).

$$\bar{p}_d = \frac{1}{N}\sum_{n=1}^{N} p_d(n) \qquad (8)$$

System Latency (L)

System latency is the time delay experienced by the system in successfully transmitting a given volume of data, therefore any system that gives moderately low or negligible latency is assumed to be fast. It is commonly expressed in milliseconds and can be given using Equation (10):

$$L = \frac{\text{total time taken}}{\text{total packets successfully transmitted}} \qquad (10)$$

Simulation of the System Model

We used MAT LAB/SIMULINK to simulate the models. The signal processing and communication block sets of SIMULINK were utilized. Simulate the network of communication. Tabular data from the simulation model's governing parameter when I first heard about MATLAB; I was used for this analysis because of its portability and graphical user interface outcomes in a logical presentation.

Table 1. Simulation Parameters for the three Models

Parameters	Model		
	Instant retry	Drop of frame	S-TDMA
Maximum Number of Stations	6	6	6
Maximum Number of Packets	100	100	100
Maximum number of retransmission	NA	3	NA
Frame length	50	50	50
Blocking period	0 ms	0 ms	200 ms
Time slot per station	180 ms	180 ms	180 ms
Modulation type	MPSK	MPSK	MPSK
Modulation order	4	4	4

System Total Link Reliability

Two other TDMA models, drop-of-frame and immediate retry, are compared to the newly designed S-TDMA model. The results of the three models are shown in Figure 3. In terms of the overall trustworthiness of the connections. A dependable link is crucial to the success of any quality indicator of how well data is transmitted across a wireless Technology for sending and receiving messages. The overall outcomes of link reliability drop-frame model for 2, 3, 4, 5, and 6 station drop-offs network percentages are 93%, 93%, 93%, 93%, and 93% respectively. Respectively. The findings indicate that overall connection reliability is high. How many

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frames are dropped in the model? Stations contribute to the network's success without being required to do so depending on how many stations are sharing the airwaves. This article calculates the overall connection reliability for the immediate retry paradigm. Station 2 is 84.00%, station 3 is 85.33%, station 4 is 97.00%, station 5 is 97.00%, and station 6 is 97.00%.

We get 92.80% and 96.00% separately. Even if the dependability has a tendency to improve as the number of stations grows, the findings of the immediate retry model show that this is not always the case. The overall dependability of a connection is proportional to the number of although stations are useful in a network, this does many stations are sharing the airwaves. Given the Based on the S-TDMA model, the stations' collective connection dependability each of the numbers 2, 3, 4, 5, and 6 has a 100% success rate. Respectively. Consequently, this proves that under the S-TDMA model, every Information that could be sent was sent without a hitch. Dissimilar to the other two models, which both areas where previously certain frames could not be sent we are already beyond the window of opportunity for transmission. S-TDMA was created to address these issues. Model accomplishes this feat because each Station is made from several in the event the primary transmitter fails, there is a backup to immediately begin broadcasting the line is available for the station controlled by the MAC. The procedure aids in take care of communication redundancy at each node network, preventing any further malfunctions.

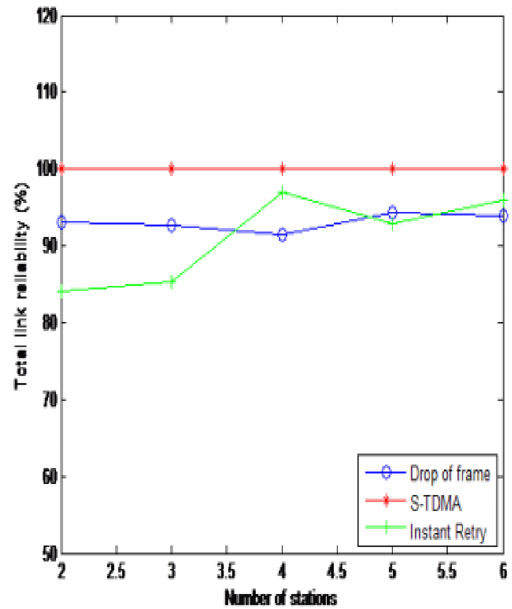

Figure 3. Total link reliability

System Throughput

The throughput of a system is the pace at which data packets are sent by the system. On display in Figure 4 is a comparison of the models' system throughput performances. The system throughputs of stations in the drop-of-frame model 2.1667 Mbps, 3.1556 Mbps, 3.1167 Mbps, 3.1667 Mbps, 3.1556 Mbps, 3.1667 Mbps, 3.1667 Mbps, The speeds range from 3.86 Mbps to 3.7667 Mbps. This demonstrates the drop-frame system throughput this model does not rely on the density of the network. Work. Throughputs in the immediate retry model The data rates for stations 2, 3, 4, 5, and 6 are 2.8000 Mbps, 2.8444 the speeds of 3.23333 Mbps, 3.0933 Mbps, 3.2000 Mbps, and 3.2000 Mbps, respectively.

Spectively. This also demonstrates that under the instant retry paradigm, system throughput is not proportional to the number of retries. Stations connected to the system. However, the frame-

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dropping modification Compared to immediate retry, el provides much greater throughput. Model. It's for this reason why the drop-of-frame model is so unpopular: duplicated images that aren't needed by the system maintain immediate transmission, but at the expense of certain data frames. S-TDMA model system throughputs for speeds for stations 2, 3, 4, 5, and 6 are 3,333,333, and 3,333,333, respectively. Speeds of 3, 3, and 3, 3 megabits per second ly. Throughput of the system is also shown by these findings. The number of stations does not matter in the S-TDMA scheme. On the web. S-TDMA, on the other hand, provides considerably rapid data transfer compared to either the drop-of-frame or immediate model-based retrying. For the reason why the S-TDMA scheme dynamic cates transmission with a retransmission internally conditional on the connectivity of the systems, which allows us to reduce or eliminate network failures and guarantee that Each and every frame was sent without a hitch.

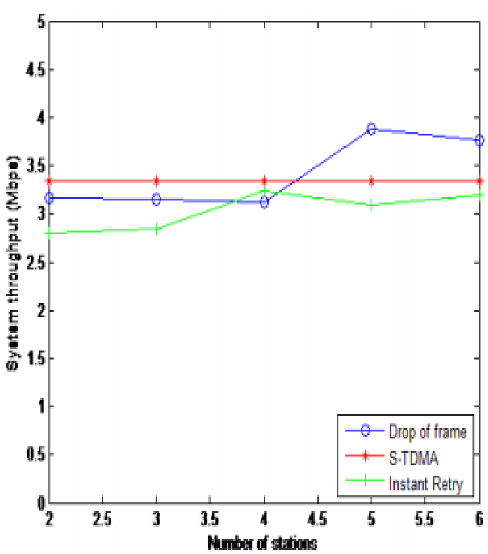

Figure 4. System throughput

Probability of Correct Delivery

That's the typical rate at which all stations meet their deadlines for sending in properly formatted frames. Measured by mean probity values, Figure 5 displays the models' overall efficacy. Capability of timely, accurate delivery with regards to radio stations the drop-of-frame model predicts 0.9500 for 2, 3, 4, 5, and 6. The values are as follows: 0.9467, 0.9350, 0.9640, and 0.9600. The In an instant retry model, 0.9919, 0.9926, 0.9910, 0.9950 and 0.9955 for the 2nd, 3rd, 4th, 5th, and 6th station. The Calculations using the S-TDMA model yield 0.9949, 0.9936, 0.9905, and 0.9894, respectively. Stations 2, 3, 4, 5, and 6 all had values of 0.9949. From Based on these findings, the Instant retry approach yields much better the comparative average of the chances of a successful delivery the frame-dropping model Because of the drop-off in whenever a frame is deemed unnecessary by the model, it is discarded.

When sending, with the instant retry model maintaining repeating transmission of the same frames until they reach the target audience; doing so increases the likelihood of Rapid retry scheme for video transmission failures. However, S-TDMA provides average probabilities that are not drastically different from those correctly delivering products when compared using a system of immediate retries. Due to the S-TDMA model additionally guarantees delivery of each individual frame to the receiver end.

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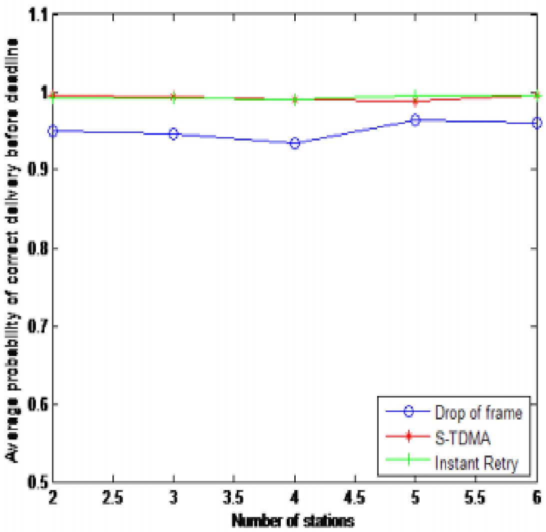

Figure 5. Average probability of correct delivery before
Deadline

System Latency

Figure 6 shows the models' latency performance. The latency of a system is the time it takes for an operation to complete. Transporting a certain amount of info. How much is this worth? Milliseconds. The drop-off locations for Stations 2, 3, 4, 5, and 6 are the model's frame yields the values 0.3158, 0.3169, 0.3209, 0.2577, and that works out to 0.2655 in each case. When using an immediate retry model, we get a value of 0.3571. 2 and 3 stations at 0.3516 and 0.3093 respectively; 4 stations at 0.3233 and 0.3125 these numbers correspond to the answers 4, 5, and 6 in the above table. 0.3000 is what the S-TDMA model predicts. For the two-hundredths station, the values are 0.3000, 0.3000, 0.3000, and 0.3000.In order: 3, 4, 5, and 6. as shown by these findings, the the drop-of-frame paradigm has a somewhat high system delay. Less than the instant retry model's retry time. This is because due to increased failures in the immediate retry paradigm resulted by sending out a redundant frame again and over, Dropping frames prevents the wait time from occurring, while any unused frame to make room for the working ones. The time period may be changed on the channel. An indication of the delay in the system nevertheless it turns out that S-TDMA holds true throughout the board network topology, the total number of stations, and there is a correlation between latency and drop-of-frame, however latency is more severe 5 and 6 stopovers respectively. So, in the case of S-TDMA, model, the delay of the system does not rely on the of stations in the network; however, the drop-of-frame

Decreases system latency as the number of stations grows, beating out S-TDMA and immediate retry models in the process.

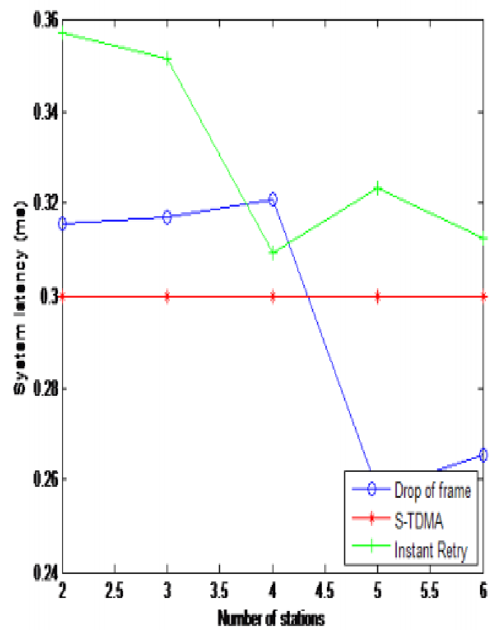

Figure 6. System latency

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Conclusions

In this research, an S-TDMA model is employed to provide redundancy and recovery for a real-time wireless network. The MAC protocol is based on Time Division Multiple Access in this concept. Using the S-TDMA MAC layer to decide which station should be allowed to broadcast within a certain time frame according to the station's current channel status. Utilizing the S-TDMA MATLAB SIMULINK was used to model the system and run simulations. This model is contrasted with two others already in use; interruption of play with immediate retry. Evaluation criteria are the measures by verify the functionality of the planned S-TDMA are comprehensive average chance of occurrence, system throughput, and link dependability timely and accurate shipment despite technical delays. The Charts and tables depict the metrics' respective outcomes. Quality of Service may be measured using these indicators (Quos) transmission of the system an evaluation of the created program has proven effective in recovering previously lost data packets. Since an efficient solution was provided by the developed model. Thus, it is recommended that you take advantage of this method of restoring lost frames. Developed for use in businesses as a defense against uncertainty in wireless networks' message-delivery capabilities successful, since its results outperform those of competing models.

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