Performance Evaluation of Line of Sight (LoS) in Mobile Ad hoc Networks

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Abstract. The era of multimedia communication is a major part and partial of each and every user life each task now depends very much on the internet. Line-of-sight is the biggest problem many are facing, while using Internet. In particular, the problem of mobile station tracking at various base stations is considered. The data is transferred more quickly in a flat area where there is no obstacles. If there were obstacles in between the mobile station and the base station, there will lot of inefficiency in data transfer. The overview of Line-of-Sight in mobile adhoc networks, various problems that arise and impairment concerned with Line of sight are deliberated in this paper. The various QoS parameters are considered for the evaluation of LoS in mobile ad hoc networks with and without obstacles.

Keywords: LoS, NLOS, mobile adhoc networks, node, hosts.

1 Introduction

Networking facilitates communication between two or more physical device programs. A computer network is a collection of computers that are connected in some way to allow data to be exchanged with others in the network. A digital telecommunications network is a computer network that allows nodes to share resources. Computer networks use connections between nodes to exchange data with each other. The data connections are made via wired or optical cables, wireless media, and other cables. Wired communication refers to the transmission of data through wired technology. Wireless communication is a kind of wireless data communication. The Line-of-Sight (LOS) is a special type of propagation that transmits and receives data only if the station is visible without a barrier between it and the transmitted or received station. Examples of line of sight communication are FM radio and satellite transmission. Non-Line-of-Sight (NLOS) is a term commonly used when the radio transmitter and receiver are not on the direct line of vision. The term is used to transmit signals using several pathways. Wired and wireless networks are different in their application areas. The performance of the both of these networks are investigated on the basis of common parameters to know how both of this networks behave. The network configuration performance is measured with a computer simulation environment.

2 Literature Survey

The wireless communication on Terahertz (THz) indoor channels is reviewed in this paper. The 0.1–10 THz wireless transmission physical mechanisms are extremely molecular absorption and loss of streaming, resulting in very high and frequency-selective path loss for a line of sight (LOS) connection [1] [2]. Depending on shape, material and surface roughness, wave propagation from THz affects very high degradation of reflection for non - line of sight (NLOS). Taking account of these THz radiation characteristics and using a scattered ray tracing method, a new deterministic channel equivalent model is developed which is responsible for both LOS and NLOS propagation cases [3] [4]. In addition, the proposed model's channel capacity will be examined. Results of simulation show that data rates in the order of terabit a second are obtained for distances of up to 1m (Tbps) with a Transmetric power of 1 Watt. In addition, NLOS only has a capacity of approximately 100 Gigabit per second (Gbps). These results motivate the development of future THz wireless systems [5] [6].

In this paper, researchers address the problem the of wireless ultra - wide band (UWB), which is necessary to increase the accuracy of applications for radiology and positioning, wireless Line - of - Sight (LOS) vs. non - Line - of - Sight (NLOS) [7][8]. A LOS / NLOS probability test approach is used on the basis of exploitation of distinctive channel impulses responses(CIR) statistical characteristics using parameters related to the “skewness” and delay of the root average square (RMS) of the CIR. For the probability densities of the CIR parameters is presented a log-normal fit. Simulation results show that there are measurable difference in their CIR parameters ' statistics between different environments (residential, office, outdoor etc.), which are used to establish the nature of the propagation channels [9]. For most types of environments, correct LOS / NLOS identification channel rates above 90 per cent are demonstrated to be attainable [10]. Further improvements are also achieved by combining statistics on CIR skewness with the delay of RMS [11].

The impact of vehicles as obstructions in the past has been largely neglected in vehicle ad-hoc networks (VANETs) [12]. Recent research has shown that additional 10–20 dB losses can be caused by vehicles obstructing the line-of-sight (LOS) path, thus reducing the intercourse [13] [14]. The impact of LOS obstacles in VANET simulations is not being modelled for most traffic mobility models (TMMs) today. This paper analyses a road scenario for the LOS obstruction caused by other vehicles [15]. First, the model following a car characterizes the movement of cars on a two-lane highway in the same direction [16]. If necessary, vehicles may change lanes. In accordance with car rules and the lane-changing rules on forward motion, the position of each vehicle is updated. For VANET simulations based on simulated traffic, a simple TMM is provided, which can identify vehicles in the shadow of other vehicles [17] [18]. The mobility model presented, together with the shadow fading track loss model, can take into account the impact of the LOS block in the overall power received multi-lane highway scenarios. [19].

Deep ultraviolet (UV) visual blind outdoor non - line communication with different transmitter and receptor geometries up to 100 m range. [20].They recommend and fit the model with a quantitative channel path loss model based on extension measurement. They observe a range-dependent power drop [21] [22]. They compare the single dispersion model and show that the single dispersion hypothesis results in a model not precise for small apex angles. Their model will then be used to study basic interactions between the transmitted optical power, range, connection geometry, data rate and bit rate. Bound detection performance is taken into account for both weak and strong solar background radiation scenarios. These findings provide guidance for the design of the system.

Simulation was an important method for the evaluation of vehicle ad hoc network (VANET) applications and protocols. [23]. Such simulations often work at the connection level with simulation time far from wall time, making it difficult to deploy real hardware analysis in hardware - in - the - loop (HIL) environments or prototypes. Probabilistic models of communication can help, but often suffer from much less accuracy than simulations at connection level [24]. It has been shown that the quality of probabilistic communication models greatly increases the determination that a communication link is of a line of sight (LOS) or non - line of sight (NLOS).

This paper presents a LOS model of VANETs in public and private environments. They find that typical urban environments like rural, urban and industrial areas have similar characteristics in various cities in Germany and in Europe. They use this to derive a probabilistic LOS model that reliably predicts and performs associated work [25]. Therefore, our model makes it possible to develop accurate package arrival rates models in real-time environment to study VANET technology.

3 Methdology

The Line of Sight in Mobile Adhoc Networks with various scenarios are elaborated in this section. The methodology can be depicted in the following modules

3.1 Two host communicative wirelessly

In first step, create a network with two hosts and a host is able to wirelessly send an UDP data stream as shown in Figure 1. Our objective is to make the lower - layer model protocol in the physical layer as simple as possible. A pattern contains a 600x750 meter sized playground with a space of 500 meters for two host. In addition to the host, the modules present in the network are responsible for tasks such as display, IP layer setup and physical radio modelling. Host typically in INET is the NED-type standard Host, a generic TCP / IP host template. It contains UDP, TCP, IP, application model plugging slots, and different network interfaces.

An Ipv4NetworkConfigurator module that is displayed as the configurator subsidiary module in the network assigns IP addresses to hosts. The hosts must be aware of the MAC addresses of each other to communicate, which are managed by using GlobalArp modules per host instead of real ARP within this model. Host A generates UDP packets in the model that the host B receives. To this end, host A is set to contain an UdpBasicApp module that generates 1000 byte UDP messages with exponential distribution, averaging 12ms at random intervals. The app will therefore generate 100 kbps UDP traffic and not count overhead protocols. Host B has an application UdpSink which only discards packets received.

Then focus on the radioMedium module. A radio medium module is needed for every wireless simulation in INET. This module is the common physical medium for communication. It takes into account signal propagation, attenuation, interference and other physical phenomena. The simplest model UnitDiskRadioMedium is used. It applies a variation of the disk radio unit, so that physical phenomena such as signal attenuation are ignored and the range of communication is simply defined in metres. In-range transmissions are always received correctly, unless there are collisions.

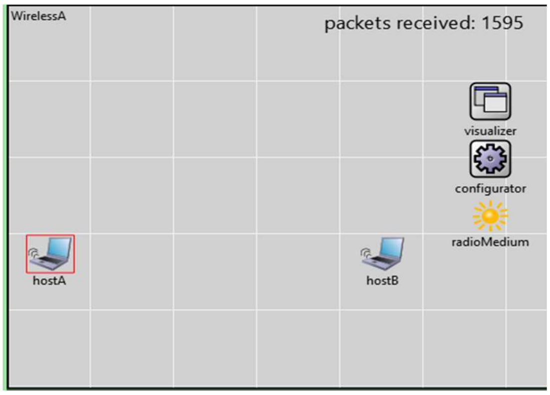

Figure 1: Two Hosts Communicating in Wireless network.

3.2 Adding more nodes and decreasing the communication range

In this step, model is converted into an ad-hoc network and routing experiment. Two original hosts A and host B can communicate with each other directly, and add another three more wireless nodes and reduce the range of communication. By reducing the all hosts to 250 meters in communication and their distance is 400 metres, so direct communication between two hosts A and B is not possible. The additional hosts are located in the right positions for data transmission from two hosts, A and B, but routing is still not set up. It is therefore impossible to communicate with hosts A and B.

3.3 Establishment of static routing

To set routing for packets to flow from host A to host B in this step. The intermediate nodes must act as routers at this stage. IPv4 transmission must be allowed for the recently added hosts to act as routers. The Ipv4NetworkConfigurator module provides static IPv4 configuration, with address assignment and routes adding. The configurator assigns IP addresses within the range of 10.0.0.x and creates routes based on estimated link error rates. NetworkRouteVisualizer module for the visualizer submodule that is capable of rendering packet paths in this network. This module shows paths where a packet was recently sent between the two end hosts network layers. The path is shown to the visited host as a coloured arrow. The path continues to disappear and after some time unless it is strengthened by a different packet. Then set the disc radio interference range to 500 m, twice the communication range. In the UnitDiskRadio receiver section, set the ignoreInterference parameter to false to enable interference modelling. Interference range is the UnitDiskRadio transmitter part interference range parameter set to 500 m.

Then activate the recognition by triggering CsmaCaMac's useAcks parameter. The change on the recipient side is quite simple: if the MAC receives a data frame addressed correctly, it answers after a fixed longitudinal gap (SIFS) with an ACK frame. If ACK is not received properly by the originator of the dataset within the due time, a transmission is initiated.

3.4 Power consumption

Hosts contain an energy storage component which models a source of energy like a battery or a power supply. In the energyStorageType parameter of the host, INET contains several models to store energy. The energy consumption model of the radio is also preconfigured to draw energy from the energy storage system of the host. (Are also possible hosts with more than one energy storage component).

In this model, IdealEpEnergyStorage in hosts are used. IdealEpEnergyStorage offers an endless amount of energy that cannot be fully loaded or exhausted. By using IdealEpEnergyStorage, it is not only focus on storage, but also on energy consumption.

3.5 Configuring node movements

The mobility submodule of hosts under the INET Framework manages node mobility. There are various types of mobility module that can be connected to a host. Here LinearMobility is installed in the intermediate nodes. LinearMobility implements movement along a lines with parameters of heading and speed. Set the nodes to move north at a speed of 12 m / s.

3.6 Configuring ad-hoc routing (AODV)

The hosts are converted into AodvRouter instances. AodvRouter is like Wi-Fi, but with an additional submodule AodvRouting. Every node becomes an AODV router. The Ad-Hoc Distance Vector stands for AODV. Routes are laid down as needed in AODV. When a route has been established, it is kept as long as necessary.

The network silences in AODV until a connection is necessary. The network node requiring a connection at that point transmits a connection request. This message is forwarded to other AODV nodes, which record the node they heard from and create a temporary track explosion back to the needed node. If a node receives a message and has a route to the desired node, a message on a temporary route will be sent back to the requested node. The need node then begins with the route via other nodes with the least hops. Unused entries are recycled after a while in the routing tables.

AODV defines Route Request (RREQ), Route Response (RERP) and Route error (RERRs). Messaging types AODV defines.

3.7 Adding obstacles to the environment

Objects such as walls, trees, buildings and hills are in reality an obstacle to the spread of radio signals. They absorb and reflect radio waves, lower the quality of the signal and reduce the risk of success. In this step, a concrete wall is fitted in between the hosts A and R1. Use of the perfect radio and wireless medium models that do not allow physical phenomena, modelling obstacles will be very simple: every barrier absorbs radio signals completely, making reception impossible behind them.

Obstacles are described in an XML file. An obstacle is defined by its shape, location, orientation, and material. The XML format allows us to use a predefined form like a cuboid, prism, a polyhedron or a globe and also define new shapes that are used for any number of obstacles. This may also have a name and can define how it should be rendered (colour, line width, opacity...) similar to materials: pre-defined materials are available such as concrete, brick, wood, glass, and new materials can also be defined. The physical characteristics of a material such as resistivity, relative permittivity and relative permeability are defined. These characteristics are used in dielectric loss tangent estimations, refractive index and signal propagating speeds, and ultimately in signal loss estimations.

3.8 Changing to a more realistic Radio model

In this step, UnitDiskRadio will be replaced by ApskScalarRadio. ApskScalarRadio designs a radio that uses the modulation scheme APSK (amplitude and phase-shift keying). It uses BPSK by default, but it can also configure QPSK, QAM-16, QAM-64, QAM-256 and many other modulations. The ‘disk unit’ type of abstraction, defines the carrier frequency, signal bandwidth, and the transmission capacity of the radios. (Modulation is the transmitter component parameter.) They will allow the radio station and receiver models, along with other basic parameters, to calculate the loss in track, SNIR, bit error rates and other values and eventually determine the recipient's success. ApskScalarRadio also provides realism by simulating a preamble and a physical layer header preceding the data. Its lengths are parameters too (and if not required, they can be set to zero).

3.9 Configuring a more accurate path loss model.

Figure 2 shows the medium uses a model for free-space loss of paths that assumes a line of sight path without causing any obstacles in close proximity.

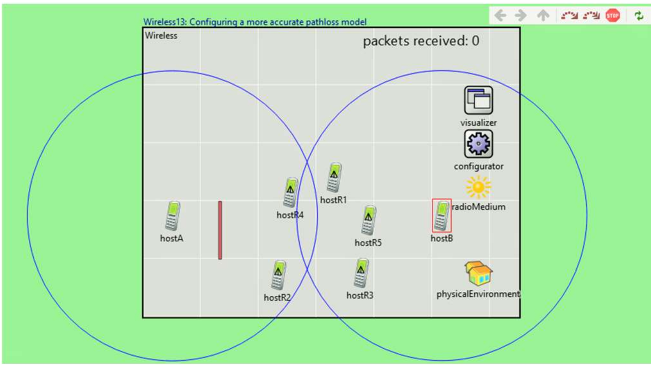

Figure 2: Configuring a more accurate path loss model

As wireless hosts go on the ground, the two-ray floor reflection model calculating with a reflection from the ground would be a more accurate path loss model. FlatGround is used as ground model to enter into the physical environment module. The height of the floor is FlatGround's height parameter. The parameter is set to 0m.

3.10 Introducing Antenna Gain

In the previous phases, a radio antenna with an increase of 1 (0dB) is used. To improve the simulation, ConstantGainAntenna is used to increasing the antenna gain.

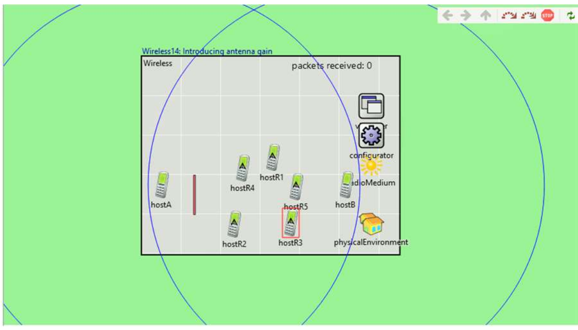

Figure 3: Introducing Antenna Gain

Here configure the hosts ConstantGainAntenna is an abstraction is shown in the figure 3. An antenna that has a constant gain in the directions relevant for simulation, no matter what the real-life application of such antenna may take. For example, if all nodes on the same plane on a simulation wireless network, ConstantGainAntenna could be equivalent to an omnidirectional dipole antenna.

4 Result Analysis

Here, chosen the version 5.4 of OMNeT++ (Objective Modular Network Testbed). The INet Framework for OMNeT++ Object - oriented modular event simulation network framework with the 4.1.0-ae90ecd release. Using OMNeT++, Communication networks and other distributed systems simulation is performed INET consists of a number of application models for simulations. It is an open source tool which follows the fundamental language of object oriented language called C++. The trace file and graphical analysis can also be done using the same. The detailed analysis of the results are elaborated in this section.

Throughput analysis of two hosts will show in Figure (4) and (5), Throughput is the maximum production rate or the maximum rate for processing anything. In the context of communication networks such as Ethernet or packet radio, throughput or network output, the rate of successful delivery of messages via a communication channel is used.

Formula 1, to calculate the Throughput value of two hosts using the formula,

Throughput (T) = No of packets/Unit time (kbps). (1)

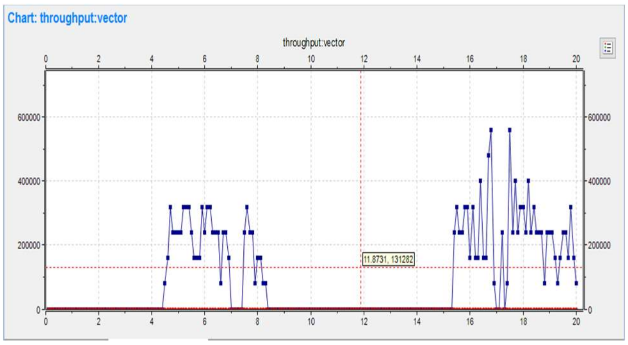

Figure 4: Throughput vector graph of two Hosts when Obstacles between them.

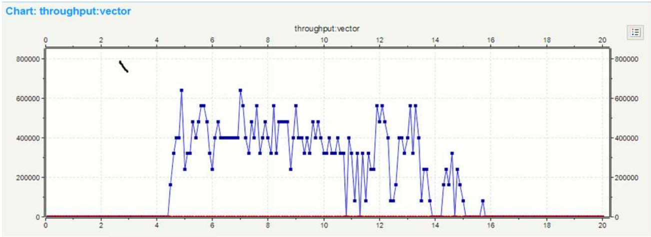

Figure 5: Throughput vector for Antenna Gain for Line of sight Communication.

In the Figure (6) and (7) depicts the End-to-End delay, It refers to the time to it takes to transmit a packet through a network. It is a common term in IP network monitoring and differs in that only the path from source to destination in one direction is measured from round-trip time.

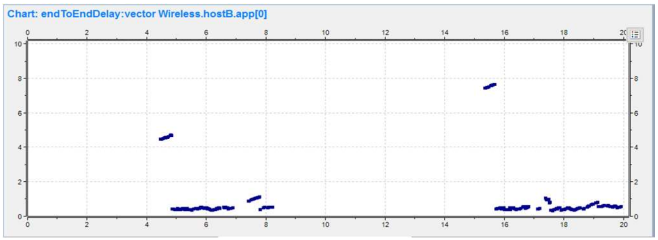

Figure 6: End-To-End Delay due to Obstacles between Host A and Host B.

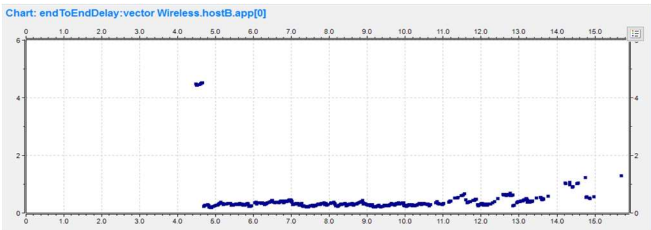

Figure 7: End-To-End Delay due to Obstacles between Host A and Host B after Antenna Gain.

In the Figure (8) and (9), shows the Power Consumption of two hosts in terms of both consumption and capacity growth, the rate of growth of the internet means that it is not likely to achieve a realistic objective to actually cut its overall energy consumption. Energy efficiency refers to the amount of data that can be transmitted by the energy consumed by the network from one end to another.

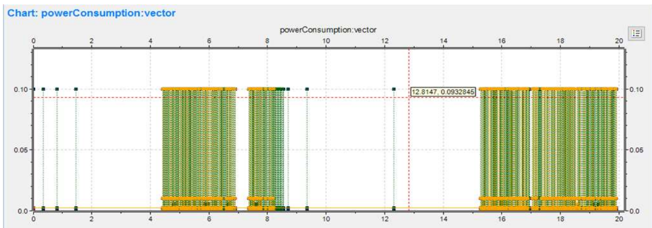

Figure 8: Total Power Consumption of Host A and Host B Due to Obstacles between them.

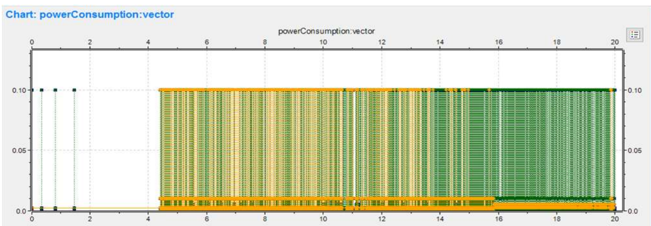

Figure 9: Total Power consumption of Host A and Host B after the Antenna Gain.

As shown in the Figure (10) and (11) depicts the Transmission state of the Hosts in terms when the transmission of data is the transmission of digital or analog data to one or more electronical devices via a communication medium. It enables devices in the point-by-point, point-by-multipoint and multipoint environment to be transferred and communicated. The transmission of data is also known as digital or digital transmission.

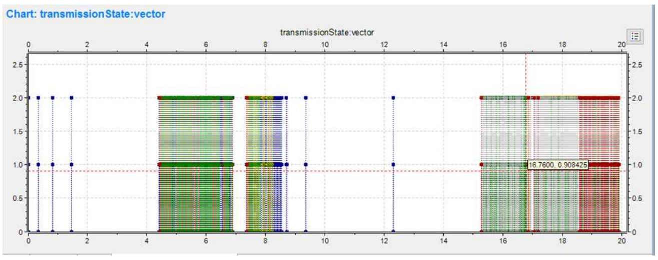

Figure 10: Transmission State of Hosts, When Obstacles between them.

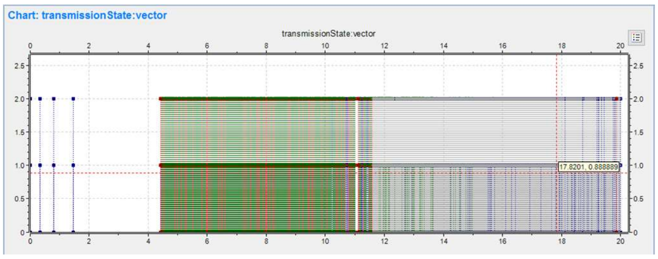

Figure 11: Transmission State of Hosts, When Obstacles between them after increase Antenna Gain.

For each packet transmitted and each packet received, a node loses a particular amount of energy. The initial Energy value is therefore reduced in a node. After receiving or transmitting packets the current energy value in a node is the residual energy.

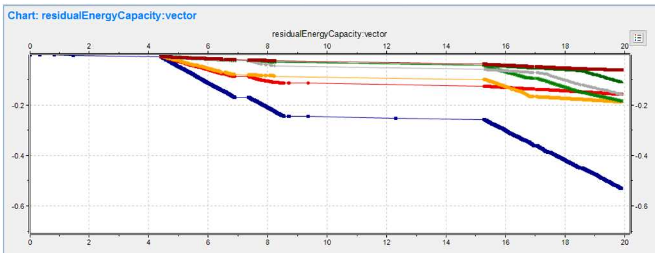

Figure 12: Residual Energy Capacity of Hosts when pass loss of Hosts due to Obstacles.

At the end of the simulation, the Figure (12) and (13) shows the host an energyBalance variable. The negative value of energy means energy consumption. The residualCapacity statistic of hosts A, R1 and B is plotted in following diagram. The diagram shows that host A has consumed the most power because it transmitted more than the other nodes.

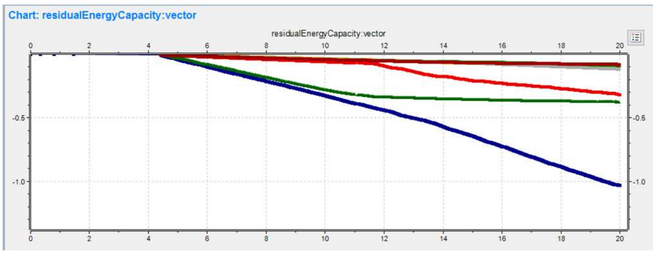

Figure 13: Residual Energy Capacity of Hosts when pass loss of Hosts due to Obstacles after increase the Antenna Gain

5 Conclusion

In this paper, they analysed the Line of Sight in mobile adhoc network. From the above scenario, we conclude that the line of sight will be lower if more obstacles come between the networks. They showed every problem and how the network properties are implemented in the various scenarios in Line-of-Sight problem. The QoS parameters such as Throughput, Transmission rate, End-to-End Delay, Power Consumption and Residual Energy Capacity for the evaluation of Line of Sight. It is evident that performance will be better in a case here obstacles will be less. In future a LoS aware technique will be developed to provide better outcomes compared to existing methods for live multimedia transmission.

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