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Research on the Construction of Evaluation Platform for Multimedia Transmission in the Internet

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Abstract

All kinds of multimedia data are now transferred via network, which need high level QoS standard because of different compression parameters, network parameters and the status of the network. In this paper, we first discribe relevant parameters and results of the correlation between these parameters by using a novel simulation tool. Usually the factors that affect the transmission of the multimedia in the network generally include: GoP (Group of Picture) pattern, compression quantitative parameters (Quantization Value), the Packet length (Packet Size) and Packet Error Rate (Packet Error Rate). Then, based on the basis of Evalvid and NS2 simulation platform, a new set of tools group are set by integrating these two tools. Video traffic trace file is used to evaluate the network structure in existing research and image quality. Moreover, further study of correlation between these factors and image quality is conducted.

Keywords: *Mutimedia transmission, Group of Picture, packet error rate, simulation platform*

1. Introduction

With the rapid development of the Internet and multimedia technology, the Internet has gradually from a single data transmission network to an integrated transport network data, voice, images and other multimedia information evolution. Due to the large amount of data moving images, in specific applications, network topology, network bandwidth, routing technology and other factors will affect the network transmission performance, and ultimately affect the quality of service video services. Therefore, a need for studies on the quality of the network video transmission, in the research process, due to the complexity of the constraints and economic conditions of the network, network simulation technology has played a very important role [1].

MPEG-4 [2] the first edition was completed in 1998, the second edition was completed in 1999. The initial name is very low bit rate audio video coding, the goal is defined as audio and video encoding. Disappearance rate restrictions applicable rate implies a wider range of video and audio encoding and put into video and audio encoding object is the objective of a qualitative leap. The main objectives of MPEG-4, there are two: First, low bit rate multimedia communication, and the second is a comprehensive multi-media communications industry. Accordingly target, MPEG-4 audio is introduced - Video (AV) objects, so, MPEG-4 standard is to focus on the AV object (natural or synthetic) encoding, storage, transmission and compositions developed, high-efficiency encoding, organization, storage, transmission AV object is the basic content of MPEG-4 standard.

MPEG has advantages in three areas. First, it is used as an international standard to study the development of, and therefore have a good compatibility; secondly, MPEG to provide better compression ratio than other algorithms, up to 200: 1; More importantly, MPEG at the same time provide a high compression ratio, the data loss is very small. It

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can be said, MPEG-1 [3], MPEG-2 [4], MPEG-4 to meet the future for a long period of time it needs to multimedia data compression. [5]

H.264 is the ITU-T Video Coding Experts Group (VECG) and 150 eight EC's Moving Picture Experts Group (MPEG) to develop research to adapt to a new generation of low bit rate transmission of video compression standards. H.264 standard coding framework consistent with existing video compression coding framework, are block-based hybrid coding method, which uses a new coding techniques, such as intra-prediction, variable block size motion compensation, multiple reference frames forecast, a / 4 pixel accuracy motion estimation, 4x4 integer DCT, go to the box filters, etc., its performance is much higher than other criteria.

2. Factors Image Transmission Quality Impact

2.1. GOP (Group of Picture) Pattern

In general, MPEG image can be decomposed into a GOP to be encoded as a unit operation, in Table 1 GOP are several different types.

Table 1. Different Types GOP

GOP Serial number	GOP Name	Frame sequence	GOP Length
00	gop00	IBBPBBPBBPBB	12
01	gop01	IIIIIIIII...	1
02	gop02	IPIPIP...	2
03	gop03	IPPIPPI...	3
04	gop04	IPPPIPPPI...	4
05	gop05	IBIBI...	2
06	gop06	IBBIBBI...	3
07	gop07	IBBBIBBBI...	4
08	gop08	IBBPBBPBBPBB	Entiresequence
09	gop09	PBBPBB...	
10	gop10	IBBPBBSPBBPB	Entiresequence
		BSPBBPBB...	
		IBBPBBSPBBPB	12
		BI...	

Here we give the most common type of GOP, for example, as shown in Figure A GOP pattern with two parameters can be expressed generally G (N, M) to indicate, N value represents the number of frames from one I-frame to an I-frame between a lower, and M represents from I-frame to the next P-frame, or P-frame to the next number between P-frame picture. In Figure 2 as an example, GOP pattern available G (12,3), said there were so between I-frame and I-frame 12 the number of screens, and a total of three screens between the number of I-frame and P-frame, Therefore, in this embodiment, one GOP, there will be an I-frame, 3 P-frames and eight B-frames. In addition, the figure also shows that the second start of the next I-frame represents one GOP, the arrow indicates the P-frames and B-frames is based on the I-frame or P-frame is performed before or after codec.

2.2. Compression Quantization Parameter (Q value)

Quantification (Quantization) [6] to reduce the number of bits of each coefficient describing, which is a rough description of each coefficient measurement units. Quantification has two functions:

1 so that the original value very close to zero as possible to zero.

2 so that the range of the original non-zero coefficients becomes small, helping to increase the degree of compression.

Quantization is destructive compression technique, when the data after quantization is then reduced, and the original data is not exactly the same, and therefore the degree of distortion after compression, depending on the quantitative criteria (Quantization Scale). Because some of the unique characteristics of the human visual signal changes are often difficult to detect high spatial frequencies, it can be used to represent a larger standard, as far as possible to zero, or even ignored. To the human eye, it will not cause much of a difference, but human vision is often easier to detect low-frequency signal changes, so a low-frequency signal smaller standard should be adopted, so that the signal does not differ too much to restore the original signal much.

During image coding, we can use different criteria to quantify image compression, but pay special attention to that, the choice of a relatively large quantitative criteria will encode the image quality becomes poor out, but the amount of data required will be smaller; while elected with a relatively small quantitative criteria, although the coding out of the picture quality will be better, but it requires a relatively large amount of data. Affects the size of the data to be divided by the number of packets per frame. Packet loss situation if the number of packets in the network too bad condition, each frame to be split, then, this time containing this frame will increase, thus increasing the probability of frame can not be decoded, so in this case at this time next, you should use a larger quantitative criteria, so that reduces the amount of data frame. At this point though when encoding will reduce the image quality, but out of the picture decoding than the solution does not come out of the image quality is better.

2.3. Packet Length (Packet Size)

Transmission of images over the network, the packet length will affect the number of packets per frame carved out, in addition, the size of the packet length itself will affect the size of the packet error rate on the network, the number of packets and packet error rate is two important factors when transmitted over the network multimedia streaming.

2.4. Packet Error Rate (Packet Error Rate)

When video streaming on the network, packet error rate on the network will seriously affect the quality of the transmission of the image, as if on a network packet error rate is too large, then the probability of packet loss becomes larger, this time because of today's image most coding technology is the use of hierarchical coding (Hierarchy Coding) method (I-frame packet loss will lead to I-frame cannot be decoded, and this time in the same GOP in the P-frame and B-frame to this cannot be decoded with reference to I-frame, P-frame and so the B-frame cannot be decoded because the I-frame cannot be decoded successfully, similar to this method is called a hierarchical coding encoder). Therefore, out of the front of the packet loss may result in no way to decode the subsequent frame, and therefore it is easy to cause the transmission of the image quality becomes poor stream, so a packet error rate on the current network will greatly affect the transmission of the image streaming.

3. Integrated NS-2 and Evalvid

3.1. Introduction

With the rapid development of the Internet, network size and applications are rapidly expanding and network technology problems are more extensive and complex research networks technology has become a hot research field of the current network. However, due to the complexity of the network, the current network technology research is largely limited to the theoretical research, application in practice more difficult. With the development of computer technology, simulation tools play a significant role in the analysis and research of complex networks. So seek superior performance simulation tool for the study of network technology has a very important role.

3.2. Simulation Network Structure

In order to image transmission quality in wireless networks to assess the use of network simulation software to create a fake.

True model, configuration, as shown in Figure 1.

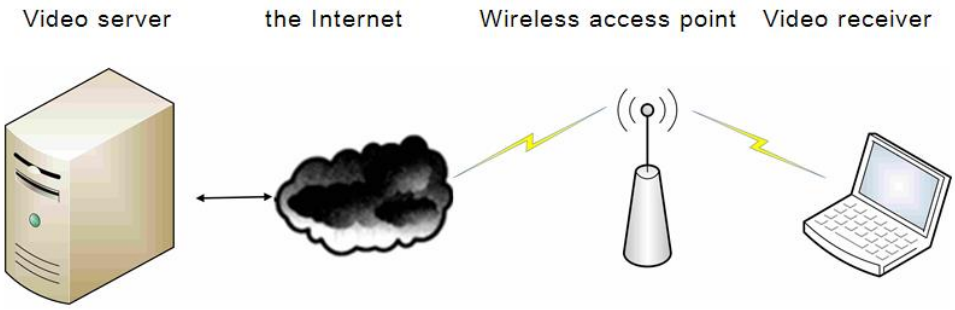

Figure 1. Simulation Network Structure

Video server and wireless network to the video receiving end, between the video server and wireless access point connected to a wired network because of this simulation environment assessment is a wireless network, so it is assumed that does not occur on any of the wired network packet loss figure the wireless network uses a protocol on this wireless network packet loss happens, and thus will lead to the transmission of video quality deterioration.

3.3.Evalvid and Improved myEvalvid

Evalvid system block diagram shown in Figure 2.

Evalvid system includes video transmitter, evaluation modules, repair video module, PSNR value calculation module and the MOS calculation module, and these modules is mainly through the trace file will connect the various modules. Workflow Evalvid system are as follows: a video produced by the sending end video tracking files, and the packaged video stream file is sent to the network to go through tcpdump network analysis tool, intercepted video packets of video data packet header information (including timestamp, packet ID number, the data packet payload) were analyzed, a trace file of the sending end, the transmission through the network, tcpdump to capture the received video data packet information, the receiving side is the trace file. The two trace files so obtained (including the sending and receiving ends) together with video tracking file into the evaluation module, resulting reconstructed video sequence containing the packet loss, and has been included loss, delay and delay jitter (jitter) of QoS reports. Reconstruction by

repairing module contains the loss of video sequences, video sequences repaired, the repair of a video sequence and compare the source video sequence, calculated PSNR values to calculate MOS get video transmission quality of service (QoS) levels.

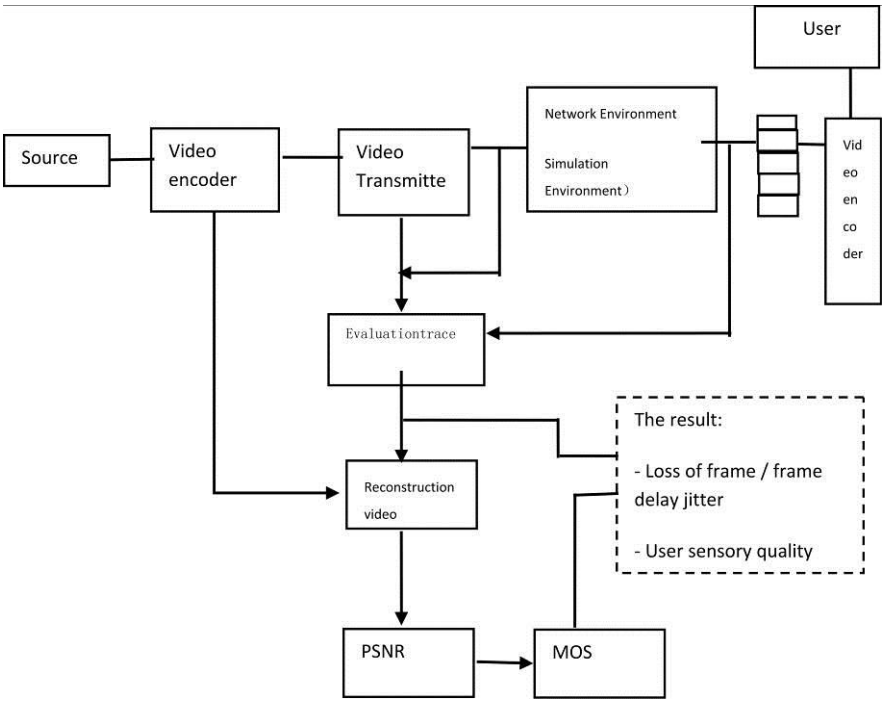

Figure 2. Evalvid Framework

The main parts of the system functions are described below:

(1) video source format

Support YUV QCIF (176 × 144), YUV CIF (352 × 288) format.

(2) video codec

Primarily responsible for the input video source files codec operation.

(3) video transmission side

The main compressed data is read after the video source from the video encoder, and the data are divided into smaller blocks according to the set division size, then RTP / UDP incoming real or simulated way network environment. In a real network environment video sending end module through third-party tools, such as tcpdump or windump credited timestamp, packet ID and packet payload size. Video transmitting side can also generate a video trace file containing video information. The sender trace file and the video trace file will be used to assess the quality of the video transmission.

(4) Evaluation Module

When the transfer is complete, begin by transmission network video for evaluation. Assessed the transmission side and, therefore, the receiving side must be the tracking file includes a video time stamp, the packet ID and the transmission payload size of the data packet back to the transmitting end. In Figure 1, a real network environment, the tools tcpdump by the receiver will produce a document back to the evaluation module, and the assessment will generate a tracking module includes a frame / packet loss, delay, delay jitter, and reports. Meanwhile, the video

transmission through the network will enter into playback buffer module, evaluation modules will be defined as loss: If a video frame arrival time is greater than the playback time, the frame is recorded as loss. Playback buffer size is an option, the buffer size can be defined, if not define, will be set to an initial value.

(5) Repair Video Module

The video quality is assessed by frame. Therefore, the total number receiving end video including the number of error frames must be the same as the total number of frames in the source video, if the decoder cannot handle missing frames, repair video module will insert the last few frames can be successfully decoded as an error concealment technology.

(6) PSNR (Peak Signal Noise Radio) calculation module

PSNR is recognized as a method of evaluating the application layer QoS standards. PSNR can be calculated by the video and the original video reconstruction error. Before transmission, the sender can calculate the value of video compression PSNR between the original video and at the end of the transfer, the receiving end PSNR value calculated reconstruction between the video and the original video, by comparing the two PSNR values to evaluate QoS quality.

(7) MOS (Mean Opinion Score) calculation module

MOS is a subjective evaluation criteria of the application layer, the MOS value range of from 1 to 5, different PSNR values reflect different MOS values, the mapping relationship between the PSNR and the MOS as shown in Table 2.

Table 2. Mapping between the PSNR and MOS

PSNR/dB	MOS
>37	5 (excellent)
31~ 37	4 (good)
25~ 31	3 (fair)
20~ 25	2 (poor)
<20	1 (bad)

Error model (Error Model) although Evalvid tool set also provides network model simulation, but the model is just a simple way to provide representation, would limit the use of such a model scholar or expert to verify the proposed method and structure. For example, in a wireless network, if the use Unicast to send Viedo Packet, when the packet error occurs when, MAC will be responsible for re-send the error packets, while Evalvidcan not consider such a situation.

So you want to Evalvid be improved so that Evalvid through myEvalvid, my_UDP, myEvalvid_Sink these three interface program (or you can say Agent) and NS2 do communicate. Improved system

System structure shown in Figure 3.

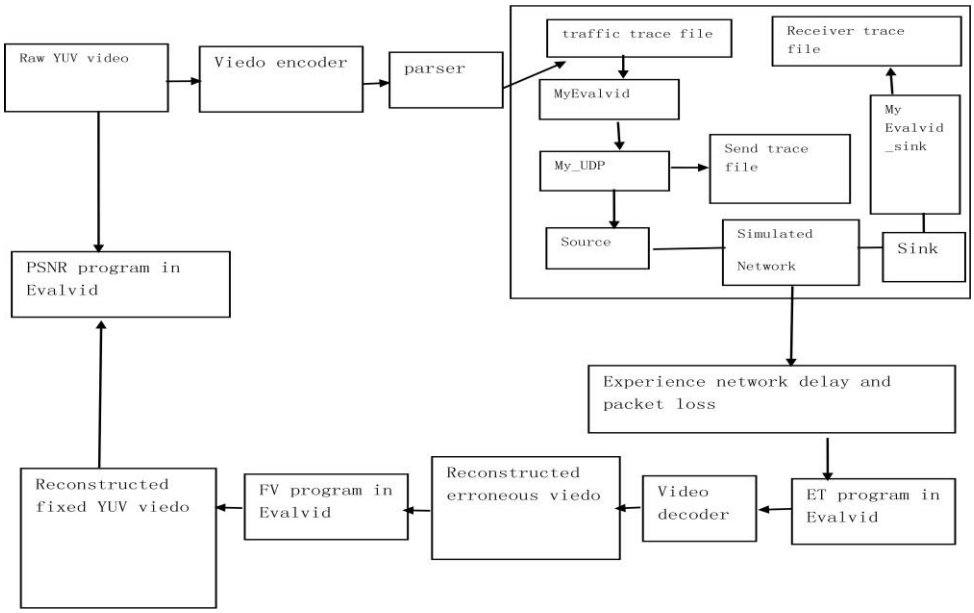

Figure 3. myEvalvid System Structure

Among them,

myEvalvid: The main job is to read through the VS interface program procedures after the movie recording file, the log file for each picture is cut into smaller pieces, and within the user to set a good time in TCL Script in these section to the lower layers of the UDP layer transmitted.

My_UDP: Basically my_UDP Agent's just an extension of UDP Agent. Agent of the time this new packet transmission, packet identification and packet payload size log file in TCL Script in the settings. Simply put,my_UDP work just as TCP-dump or work Win-dump general.

myEvalvid_Sink: myEvalvid_Sink responsible work is received by the my_UDP out packets transmitted and received by the recording time, the packet identification and a packet payload size, recorded in the file set in the TCL Script.

4. Simulation and Implementation of Network Image Transfer Process

4.1. NS2 Simulation Platform

4.1.1. NS-2 Introduction

NS- 2 is object-oriented, based on discrete event-driven network environment simulator. It enables to simulate a variety of network protocols, such as TCP transport layer, UDP protocol, FTP application layer, Telnet, Web protocols, to achieve several router queue management mechanism DropTail, RED, *etc.*, and Dijkstra, dynamic routing, static routing, multicast routing routing algorithms. In addition, NS-2 also supports multicast protocol Association SRM and some MAC layer.

NS-2 with the C + + language and Otclmade. It's an outstanding advantage is that it's all open source code, provides an open user interface and easy to extend, configuration, users can easily develop their own new protocol module integrated into the NS-2 environment.

NS-2 platform that can run Unix, Windows. But in the Unix operating relatively stable and easy correction. It is generally NS-2 simulation run under Unix platforms.

4.1.2. Hierarchy of NS-2

NS-2 the overall structure shown in Figure 4.

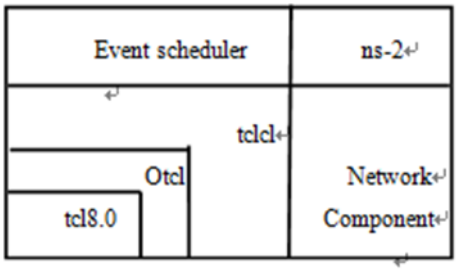

Figure 4. NS-2 Overall Architecture

NS-2 with a two-level architecture, in order to improve the efficiency of the code, NS-2 data and control parts of the operation to achieve phase separation, event scheduler and most basic network component objects in the background using C ++ implementation and compilation, called compilation layer, the main function is to achieve packet processing; front NS-2 is a Otcl interpreter, called the interpretation layer, the main function is to simulate the environment configuration, build. From the user's perspective, NS-2 is an event-driven simulation has the network component object libraries, and network configuration module library Otcl script interpreter. NS-2 class objects compiled by Otcl connection established corresponding interpretation class object, so that the user may be able to easily to functions and variables C ++ object to be modified and configured in Otcl space, fully reflects the consistent and flexible emulator sex.

4.1.3. NS-2 Function Modules

Typically, start simulator simulation work is by creating an instance of a Simulator after class begins. Simulator class can be seen as the entire emulator package, including members of the class node, link, agent, package, LAN and so on.

We create an instance of an object emulator started calling various methods to generate through this simulator

Node, and then construct the topology map, for each object simulation configuration, define the event, then the event is defined according to simulate the entire process of network activity. When you create a simulator object in the constructor also creates an event scheduler of the simulator (Event Scheduler).

Emulator encapsulates many functional modules, the basic nodes, links, agents, packet formats, and so on. The following are the explanation of these modules.

1) Event Scheduler: As NS-2 is based on event-driven scheduler NS-2 has become the dispatch center, it can track the simulation time, scheduling the current chain of events in the simulation event and the event generated by the object deal with. Currently NS-2 provides a scheduler four different data structures, which are linked list, heap, calendar and real-time scheduler.

2) Node (Node): is a composite component consists of Tcl Object objects [7] in NS-2 may represent the end nodes and routers. Each node has a unique address (id identification), the node unicast and multicast nodes of two different types of nodes, interior nodes via node type_ variable to distinguish, NS-2 is a unicast default node; node each source is connected to its business assign different ports to simulate real network port; addition, node has a routing table and routing algorithms, classification by the address to forward packets based on the destination address.

3) Link (Link): a composite of a plurality of components and is designed to connect to the network node. All links are in the form of queue management packet arrival, departure

and discarded. Increasing the Trace / EnqT in the link, Trace / DeqT, Trace / DrpT

And Tracer / RecvT and other objects can track each data packet arrives, enter and leave the queue and discarded time; You can also use the Queue Monitor (Queue Monitor) to monitor changes in the average queue length and the captain.

4) Agent (Agent): generation and load the network layer packet is received, it can be used in all levels of protocol implementations. A gent class contains source and destination addresses, packet type, size, priority, and other state variables, and use these state variables to be assigned to individual fields generated packet. Each Agent is connected to a network node (usually end node), from the node to assign it a port number. Agent is to achieve UDP protocol and various versions of the TCP protocol base class.

5) packet (Packet): the header and the data of two parts. The head includes cmn header, ipheader, tcp header, rtp header and trace headerd, of which the most common is the common header structure cmn header, the header structure contains a CD

In addition, we can also yuv player intuitive image quality differences comparing two yuv video files, as shown in Figure 5.

Figure 5. Picture Comparison

4.2. Discussion of Factors Affecting Image Transmission

4.2.1. The Correlation between the Packet Error Rate and GOP Pattern

Here, we put qscale fixed at 10, mtu set to 1024, the results in the table below.

Table 3. Correlation between the Packet Error Rate and GOP Pattern

Packet error rate	GOP 5	GOP 10	GOP 15
0.0	31.09	30.63	30.41
0.02	23.25	22.90	21.39
0.04	19.53	17.96	16.09
0.06	18.42	15.37	14.17
0.08	16.52	14.90	13.67
0.1	16.14	13.22	11.08

It is clear from the Table can be seen, the use of shorter length GOP image, its quality is better than using a longer length GOP image [8]. And can be seen in this Table, when the packet error rate is increasing, the quality between more worse, mainly because when

the packet error rate is greater when the higher probability of packet loss. At this time, if the missing packet belongs to I-frame, will result in the same GOP in the pictures are not decoded into (this is because the layer encoder characteristics). In the relatively long length GOP image, its I-frame loss must wait a long time to the arrival of the next I-frame, in which case the image will be restored to the original image screen. The shorter length of the image using the GOP, it waits for the next I-frame to time will be relatively short, so the recovery time will be relatively short, so you can get better quality, will result in a network situation worse situation next, have a very clear image quality gap between the two.

Here, we set the packet error 0.01, mtu 1024, GOP length is set to 9, the results are shown in the table below.

Table 4. Compression Quantization

Compression quantization parameter(Q)	GOP 9
2	37.68
8	32.24
15	28.70
20	26.64
25	24.21
31	23.11

From the Table, when it is compressed using the quantization parameter Q of the larger the value, the more the image quality will be poor. This is because when the image quality during compression, the quantization parameter is large is used, the compression out of the image quality is poor, therefore the image pick-up through the network to the terminal, the image quality will compare the quantization parameter even a small difference in the image, while using a smaller quantization parameter compressed, the better the image quality will result. Meanwhile, we can also find that using a smaller Q value out of the data compression ratio of more, need more packets to transmit, so the Q value is not as small as possible, according to the actual network conditions and the transmission needs to decide.

4.2.2. Packet Length Correlation between Image Quality Relevance

Here we set the Packet Error 0.05, Q value is set to 10, GOP length is set to 9, the results shown in the following Table

Table 5. Packet Length Correlation between Image Quality Relevance

MTU	AveragePSNR
200	22.45
400	27.20
600	27.96
800	29.35
1000	30.44

From the table, when the longer packet length, its image quality is higher, will result in this case the reason is this: When the same image, if used by the packet length longer needed to represent each frame is divided the fewer the number of packets, but this time because the packet error rate is the same, so the comparison with the case of using a shorter packet length, the number of packets lost its will be relatively small. While in this

case will result in more of the decoded pictures may be, it will result in a relatively high image quality, and the relatively short length of the packet using the packet, the situation is just the opposite.

5. Conclusion

This paper describes the current order of main stream video coding, network simulation tool (NS2), streaming simulation tools (Evalvid). The simulation results are analyzed and compared according to the quality of network image transmission and GOP length, packet error rate, packet length, compression correlation between quantitative criteria. In real networks, network conditions are more complex and the QoS requirement for image transmissions is related to their role. The process of image transmission in real networks are not the same as in ideal networks, that is, in real networks, a variety of factors should be taken into consideration. However, through this simulation, the method can also provide ideas for other similar studies.

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