Performance Analysis of Fountain Code in Relay Networks

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Abstract—**Packet erasure is one of the fundamental and inevitable characteristic in data transmission and data storage system. For example routers may drop a packet due to congestion. Similarly a file in a data storage system can be erased due to component failures. The problem of packet erasure exuberates for data transmission on wireless channel due to the shared medium of transmission resulting in packet collisions. In addition to packet collision for wireless channel, packet may also be erased due to channel fading, Additive White Gaussian Noise and signal attenuation. The average wireless channel erasure rate in some deployments can be as high as 20-50%. Traditional approach of dealing with packet erasure is to use replication and retransmission. The method of replication and retransmission introduces control overhead and channel wastage. In contrast, fountain codes make packets that are random functions of the whole file. The transmitter spray packets at the receiver without any knowledge of which packet are received. So the packet retransmission and replication will be reduced. The aim of this paper is to provide performance analysis and implementation of fountain codes using Luby Transform, which are currently predominant class of erasure codes**.

Index Terms—**fountain code, encoder, decoder, Luby Transform, relay networks.**

I. INTRODUCTION

The key research focuses in wireless communications is to effectively increases the throughput of wireless transmission in time-varying channels. One approach that has been widely used in current wireless system is to use a large number of physical layer configurations to adapt the channel condition. This approach however requires knowledge of channel statistics at the transmitter side which is obtained from a feedback message of the receiver. Due to the large number of physical layers configurations in both the transmitter and receiver side, the overall system complexity is high. Moreover, in such cases unpredictable channel variations the transmitter cannot precisely follow the channel condition leading to a significant performance loss [1]. A natural solution for companies that plan to efficiently disseminate large rich content over the Internet to millions of concurrent receivers is multicast or broadcast transmission. These transmissions must be fully reliable have low network overhead support vast numbers of receivers with heterogeneous characteristics and should be deployed with a minimum of server-side infrastructure investment. Activities that have such requirements include

distribution of software archived video financial information, music, and games. One method for content dissemination is to "push" content from a single source to multiple receivers, which can be achieved by reliable multicast but many applications require more than just a reliable multicast protocol since receivers will wish to access the data at times of their choosing their access speeds will vary and their access times will overlap with those of other receivers. Our general approach will accommodate both of these application styles. While unicast protocols successfully use receive-initiated requests for retransmission of lost data to provide reliability, it is widely known that the multicast analogue of this solution is unscalable.

Consider a server distributing a new software release to thousands of receivers. As receivers lose packets their requests for retransmission can quickly overwhelm the server in a process known as feedback implosion. Even in the event that the server can handle the requests the retransmitted packets are often of use only to a small subset of the receivers. More sophisticated solutions that address these limitations by using techniques such as local repair, polling, or the use of a hierarchy have been proposed [2], [3] and [4] but these solutions as yet appear inadequate [5] and [6]. Moreover, whereas adaptive retransmission-based solutions are at best unsalable and inefficient on terrestrial networks, they are unworkable on satellite networks, where the back channel typically has high latency and limited capacity if it is available at all.

Codes play an important role in many areas of science. Claude Shannon's article on mathematical theory of communication describes the twin disciplines of information and coding theory. The basic goal is the efficient and reliable communication in an uncooperative environment. To be efficient the transfer of information must not require large amount of time and effort. To be reliable the received data stream must reassemble the transmitted stream within narrow tolerances.

Fountain code is a promising strategy for transmission over erasure channels. The main idea of fountain code is to continuously transmit encoded packets is received at the destination. As such, fountain code is rateless , and it has been adopted by several standards such as Multimedia Broadcast Multicast Service (MBMS) and Digital Video Broadcasting for Handheld (DVB-H) [7] and [8].

Consider a setting where a large file is disseminated to a wide audience who may want to access it at

various times and have transmission links of different quality. Current networks use unicast based protocols such as the transport control protocol (TCP) [9] which requires a transmitter to continually send the same packet until acknowledged by the receiver. It can easily be seen that this architecture does not scale well when many users access a server concurrently and is extremely inefficient when the information transmitted is always the same. In effect, TCP and other unicast protocols place strong importance on the ordering of packets to simplify coding at the expense of increased traffic.

An alternative approach is where packets are not ordered and the recovery of some subset of packets will allow for successful decoding. This class of codes called fountain codes was pioneered by a startup called Digital Fountain and has greatly influenced the design of codes for binary erasure channels (BECs), a well-established model for the Internet.

Luby transform codes (LT codes) are the first class of practical fountain codes that are near-optimal erasure correcting codes. LT codes are rateless because the encoding and decoding principle produce an infinite number of message packets. They are erasure correcting codes because they can be used to transmit digital data reliably on an erasure channel.

We are analysis the implementation and performance evaluation of fountain code. It can perform the encoding and decoding operation using Luby Transform.

II. PROPOSED SYSTEM

In Fig. 1. Data from the source is encoded in the form of 0's and 1's. It represents the block diagram of proposed system. The encoding part uses the fountain code and it generates the bits in parallel manner and then transmitted through the channel.

In decoding side, same operation is done to decode the data. It provides parallel downloads in receiver side and it increases the channel efficiency. It reduces the time delay.

A.Data Source:

Communication is the define as the conveying information through the exchange of messages or information as by speech, visuals, signals and writing. It is the meaningful exchange of information between two or more system.

B.Encoder and Decoder:

The encoding is the process of putting a sequence of characters, letters, numbers, punctuation and symbols into a specialized format for efficient data transmission and storage.

Decoding is a opposite process the conversion of an encoded symbol back into the original sequence of characters. Encoding and Decoding are used in data communications networking and storage. The term is applicable to wireless communications systems.
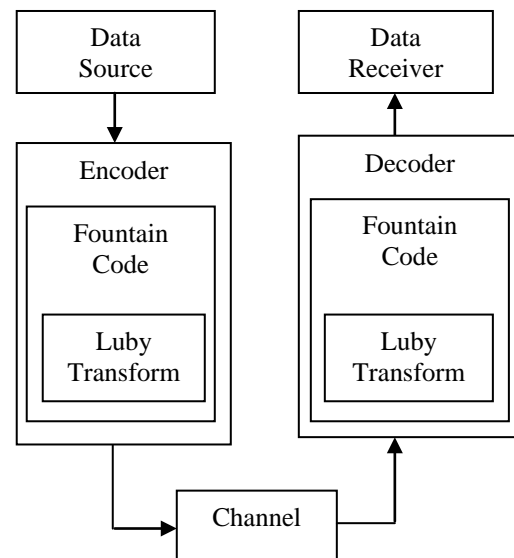

Fig.1. Block Diagram of Proposed System

The code used by most computers for text files is known as American Standard Code for Information Interchange (ASCII). ASCII can depict uppercase and lowercase alphabetic characters, numerals, punctuation and common symbols. In data communications manchester encoding is a special form of encoding in which the binary bits represent the transitions between high and low logic states. In radio communications numerous encoding and decoding methods exist some of which are used only by specialized groups of people radio operators. The earliest code of all originally employed in the landline telegraph during the 19th century is called themorse code.

The terms encoding and decoding is often used in reference to the processes of analog to digital conversion and digital to analog conversion. In this terms can apply to any form of data including text, images, audio, video, multimedia, computer programs and control systems. Encryption can be done without changing particular code that the content encoding can be done without deliberately concealing the content.

C.Fountain Code:

Reliable wireless broadcast has gained significant interest with the standardization and introduction of multimedia broadcast and multicast services into wireless cellular networks. Whereas many types of

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multimedia data tolerate residual errors to some extent like video streaming or audio distribution in general file download must be performed error free. Broadcasting wireless receivers in a cellular environment results in diverse receiving conditions for different receivers. But link adaptation cannot be utilized in the broadcast mode. Therefore approaches based on Automatic Repeat reQuest (ARQ) have been proposed and protocols for broadcast transmission. However all retransmission strategies require feedback channels from the receivers to the transmitter.

Furthermore the system throughput applying ARQ is degenerating with a growing number of receiving entities. This phenomenon is also known as feedback implosion. Alternatively Forward Error Correction (FEC) with a fixed code rate can be applied. This results creates an unnecessary reception overhead for receivers with good channel conditions and residual errors for receivers with bad or moderate channel states. Moreover both solutions do not allow asynchronous access of receivers to the data. However FEC for reliable broadcast was investigated by fountain code. The practical implementation of fountain code by using Luby Transform (LT). LT Codes solve the reliable broadcast problem without requiring feedback channels. Traditionally these codes were investigated on erasure channels that have been proposed for Internet communication.

D. Luby Transform:

LT codes are the first practical rateless codes for the binary erasure channel. The encoder can generate as many encoding symbols as required to decode n information symbols. The encoding and decoding algorithms of LT codes are simple they are similar to parity-check processes. LT codes are efficient in the sense that the transmitter does not require an acknowledgement (ACK) from the receiver. This property is especially desired in multicast channels because it will significantly decrease the overhead incurred by processing the ACKs from multiple receivers.

Operation in Luby Transform:

In Luby Transform the main function is done by XOR operation, here the encoded data will have the information of the neighboring bits, this data will be enclosed and transmitted, at the decoder side the bits will be received in a random manner. The data will be arranged in an order based on the neighboring bits. This neighboring bits can also used to regenerate the bits in case of lose of bits. Finally the redundant bits and the information bits will be separated and the redundant bits will be eliminated.

The Luby Transform operation are as follows:
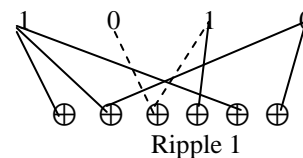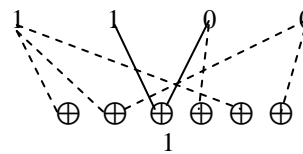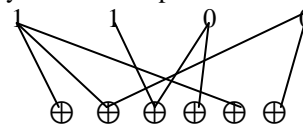
III. RESULTS AND DISCUSSION

Tarang modules are designed with low to medium transmit power and for high reliability wireless network. The modules require minimal power and provide reliable delivery of data between devices. The interface with the modules helps to directly fit into many industrial applications. The module operates within the ISM 2.4 - 2.4835 GHz frequency with IEEE 82.15.4 baseband. Fig. 2. represents transmitting data by using the AT command. The AT command provides the connection between module in the form of source and destination address. It represents the both time and byte in transmission and reception data.

It can perform unicast, broadcast and peer to peer network. In unicast network the communication happens only between the modules with respective source and destination addresses. In such network as shown in fig.3 destination address of the TARANG 1 is source address to TARANG 2, and vice versa. For any effective communication the source address and destination address should be configured properly.
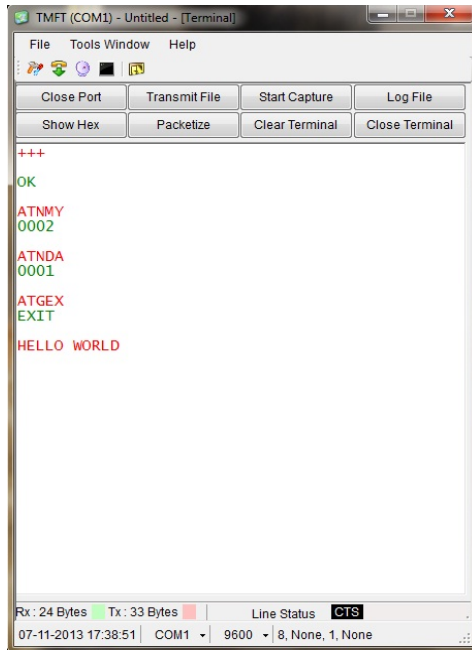
Fig. 2. Screen View of the Sample Transmitted Data

Fig. 3. Screen View of the Sample Received Data

IV. CONCLUSION AND FUTURE WORK

In this paper an efficient data transmission through the wireless network using fountain code. This approaches when large file is disseminated to a wide audience who may want to access it at various times and have transmission links of different quality. Current networks use unicast-based protocols such as the Transport Control Protocol (TCP) which requires a transmitter to continually send the same packet until acknowledged by the receiver. It can easily be seen that this architecture does not scale well when many users access a server concurrently and is extremely inefficient when the information transmitted is always the same. In effect TCP and other unicast protocols place strong importance on the ordering of packets to simplify coding at the expense of increased traffic.

An alternative approach this codes where packets are not ordered and the recovery of some subset of packets will allow for successful decoding. This class of codes called fountain codes was pioneered by a startup called Digital Fountain and has greatly influenced the design of codes for Binary Erasure Channels (BECs) a well-established model for the Internet. It can receive the data in parallel manner. In first part data is transmitted in serial manner using Tarang Module. It provides wireless capability to any product with serial data interface. Both transmitter and receiver systems use Tarang module for data communication using AT command. In future implementation, fountain code using Luby Transform will be used to analyze their performance. This process provides the parallel data transmission and it improves the transmission channel efficiency.

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