# Multi route bandwidth optimization with enhanced compression for network backup configurations

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**Abstract.**

In this paper, we propose a novel technique QoS (Quality of Service) based frame work over the Fast IP reroute networks. In MRC (Multi Route Configurations) when a failure is detected forwards the packets over pre configured alternative next-hops, which immediately recovers from single or multiple failures, but this model does not consider QoS into account. Hence we are proposing a model which includes Optimization of bandwidth and balanced load distribution with traffic shaping. This novel framework also considers guaranteed application with reservations and also manages the network traffic. In this paper we have focused on bandwidth Optimization using compression technique.

**Keywords:** resilience, IP Fast Reroute, Bandwidth optimization , compression, Backup topology, IP payload.

## 1 Introduction

The demand on the Internet has been increased by transforming it from a special purpose network to a common platform for many online services such as online transactions, entertainment and for other e-commerce applications. Internet suffers from slow convergence of routing protocols after a network failure. The central goal in the Internet is the ability to recover from failures [1]. Generally in Internet Protocol (IP) networks, when a node/link failure occurs, the Internet Gateway Protocol (IGP) routing protocols like Open Shortest Path First (OSPF) are used to update the forwarding information based on the changed topology and the updated information is distributed to all routers in the network domain and each router individually calculates new valid routing tables. The IGP convergence process is slow, as it is reactive i.e., it reacts to a failure after it has happened, and global i.e., it involves all the routers in the domain.

This global IP re-convergence is a time consuming process, and a link/node failure is followed by a period of routing instability which results in packet drop. This phenomenon has been studied in both IGP [2] and Border Gateway Protocol (BGP) context [3], and has an adverse effect on real-time applications [4]. Though the different steps of the convergence of IP routing, i.e., detection, dissemination of information and shortest path calculation has been optimized, the convergence time is still too large for applications with real time demands [5]. Since most network failures are short lived [6], too rapid triggering of the reconvergence process can cause route flapping.

Multiple Routing Configurations [7] is a proactive and local protection mechanism that allows fast recovery. When a failure is detected, MRC forwards the packets over pre-configured alternative next-hops immediately. Since no global re-routing is performed, fast failure detection mechanisms like fast hellos or hardware alerts can be used to trigger MRC without compromising network stability [8].The shifting of recovered traffic to the alternative link may lead to congestion and packet loss in parts of the network [9]. Ideally, a proactive recovery scheme should not only guarantee connectivity after a failure, but also do so in a manner that does not cause an unacceptable load distribution.

Multi Route Configurations does not provide any approach, to capture QoS in the event of failure. Hence there is a need to focus research on QoS. Without QoS capabilities, it is impossible to offer services to
different applications.

Bandwidth is a resource that is limited, in high demand, expensive, of high value. In order to support the increase of network traffic with highly constrained resources, better managing their network traffic and bandwidth. In this context, managing traffic and bandwidth refers to managing throughput, delay, and jitter. One of the Primary component to optimize bandwidth includes compression that reduces the size of a file to be transmitted over a network [10],[11].

## 2 Related Work

MRC [7] is based on building a small set of backup routing configurations that are used to route recovered traffic on alternate paths after a failure. The backup configurations differ from the normal routing configuration in that link weights are set so as to avoid routing traffic in certain parts of the network. The link can then fail without any consequences for the traffic. MRC approach is threefold. First, creates a set of backup configurations, so that every network component is excluded from packet forwarding in one configuration. Second, for each configuration, a standard routing algorithm like OSPF is used to calculate configuration specific shortest paths and create forwarding tables in each router, based on the configurations. Finally, forwarding process that takes advantage of the backup configurations to provide fast recovery from a component failure.

The algorithm can be implemented either in a network management system, or in the routers. As long as all routers have the same view of the network topology, they will compute the same set of backup configurations. Algorithm loops through all nodes in the topology, and tries to isolate them one at a time. A link is isolated in the same iteration as one of its attached nodes. The algorithm terminates when either all nodes and links in the network are isolated in exactly one configuration, or a node that cannot be isolated is encountered [12]

Shortest path algorithm issued in each configuration to calculate configuration specific forwarding tables.. When a packet reaches a point of failure, the node adjacent to the failure, called the detecting node, is responsible for finding a backup configuration where the failed component is isolated. The detecting node marks the packet as belonging to this configuration, and forwards the packet. From the packet marking, all transit routers identify the packet with the selected backup configuration, and forward it to the egress node avoiding the failed component. [13]

Hence there is a need to focus research on QOS embedded Multiple Path Recovery Protocol. Quality of Service (QoS) refers to the capability of a network to provide better service. The primary goal of QoS is to provide priority including dedicated bandwidth, controlled jitter and latency that required by some real-time and interactive traffic, and improved loss characteristics.

## 3 Proposed frame work

In this paper we are proposing MRC based QoS frame work . The goal of this proposed model is to provide improved network "service" to the applications at the edges of the network. In other words, QoS can help improve service to the network users with guaranteed timely delivery of specific application data or resources to a particular destination or destinations

Existing system Multiple Routing Configuration does not support quality of service during backup route selected with respect to single or multiple link or node failures Hence we are proposing a QOS based Multiple path recovery with respect single/multiple link or node failures.

Fig 3.1 shows the QoS based backup configuration framework.

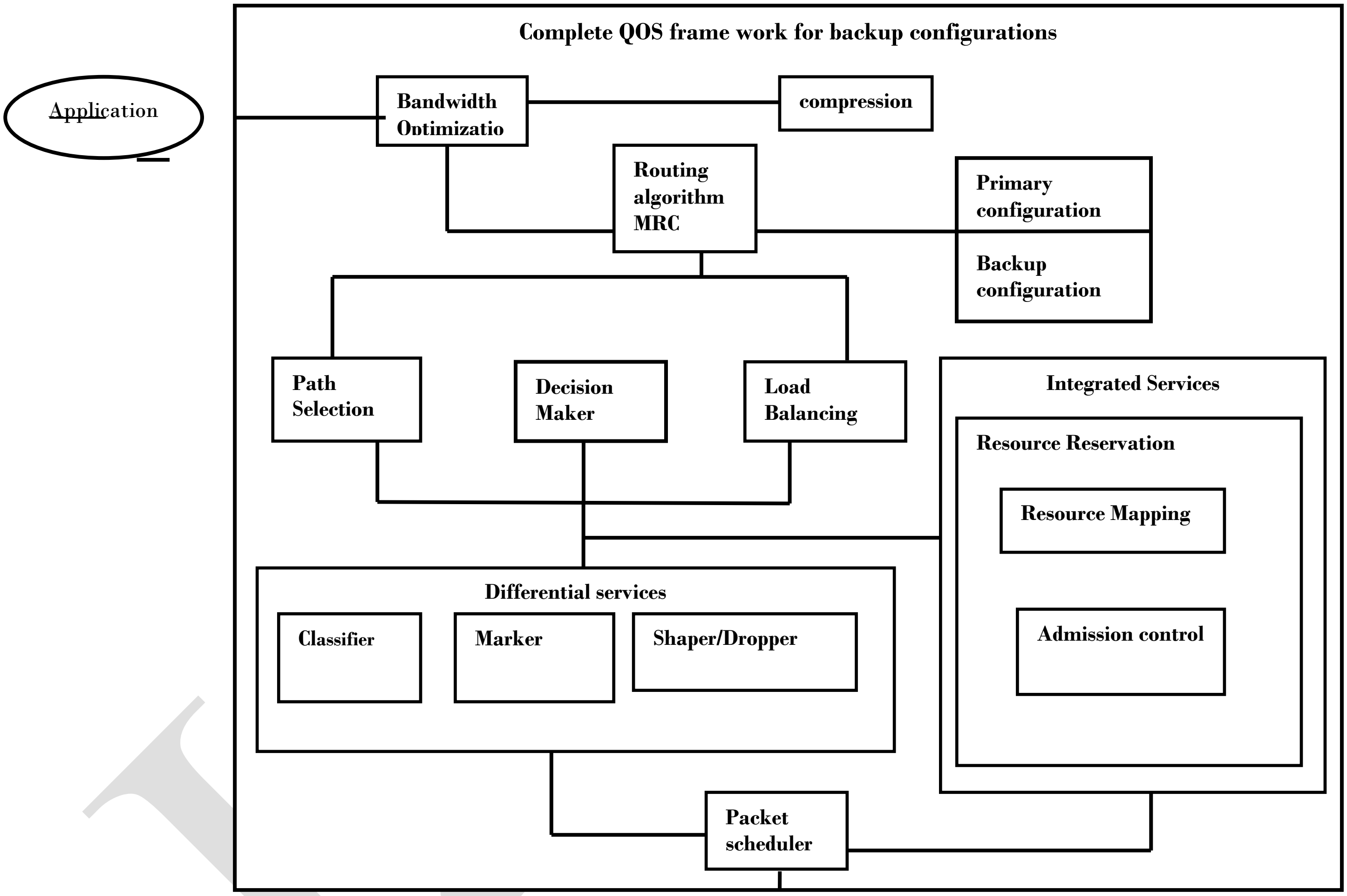


**Fig 3.1: Complete Qos frame work.**

The above frame work has following modules

**Optimization of bandwidth** usage with respect to backup configuration and maintaining total information continuity during multiple route failure. The amount of data sent in the network conspicuously affects the network performance and it also adds significant latency to the applications.

An approach, to provide **balanced load distribution and traffic shaping** with respect to backup configurations. Load balancing aims to optimize resource use, maximize throughput, minimize response time, and avoid overload of any one of the resources. Traffic shaping known as packet shaping regulates the network data transfer to assure a certain level of performance, quality of service . Delaying the flow of packets that have been designated as less important or less desired than those of prioritized traffic streams.

**An integrated service specifies** the elements to guarantee quality of Service on networks. Integrated services can be used to allow video and sound to reach the receiver without interruption. Integrated services specify a fine-grained QoS system. The idea of this module is to provide every application with some kind of guarantees to make an individual reservation.

**A differentiated service specifies** a simple, scalable and coarse-grained mechanism for classifying and managing network traffic and providing quality of Service on networks. In the Differentiated services, packets are classified and marked to receive a particular forwarding treatment (per-hop behavior or PHB) on nodes along their path. This module also includes marking, policing, and shaping operations.

## 4. Bandwidth optimization using Compression.

In order to implement this framework, in this paper we have focused on Bandwidth optimization. Various data compression techniques can be used to provide both storage efficiency as well as transmission efficiency. For applications that communicate over a network with limited bandwidth, efficient bandwidth utilization not only depends on the amount of data sent in the network. A compression mechanism is proposed over the existing MRC algorithm which provides Bandwidth optimization using Compression protocol. This size reduction decreases the time required to transmit IP packets by decreasing the number of bits that are physically transferred over the network.

Bandwidth is the total volume of traffic that can be send across a network. There are several results shows that bandwidth optimization and management relieves a real challenge to the network users. The paper shows how to manage the available bandwidth resources in most efficient way by making use of packet Compression technique.

Compression is used to reduce the size of IP datagram in order to increase the overall communication performance between a pair of communicating nodes. It reduces data throughput and thus saves bandwidth, especially over bandwidth-limited links. Fig 4.1 Shows Algorithm for Bandwidth optimization using compression

**1. Source Node initiates data transmission request**
**2. Check for the type of transmission and data size**
**3. If the size is above the reference value then**
**Compress the packet**
**4. Route the compressed packet using MRC**
**5. If switched configuration before then**
**Drop packet**
**else**
**Look up next hop in configuration table**
**6. If failed link not return from lookup then**
**Forward packet in configuration table**
**else**
**Look up next hop in configuration table**
**7. If the destination of packet matches**
**Decompress the packet**

Fig 4.1 Algorithm for Bandwidth optimization using compression

Step1 Algorithm initiated by source node for data transmission request.

Step2 and Step 3Type and packet size is cross checked if the size is above the reference values packet is compressed by invoking compression algorithm explained in section 4.1

Step 4 Algorithm loops through all nodes in the topology, and tries to isolate them one at a time. A link is isolated in the same iteration as one of its attached nodes. The algorithm terminates when either all nodes and links in the network are isolated in exactly one configuration, or a node that cannot be isolated is encountered.

Step 5 Algorithm create a complete set of valid backup configurations. Based on these, a standard shortest path algorithm issued in each configuration to calculate configuration specific forwarding tables. In this section, we describe how these forwarding tables are used to avoid a failed component.

Step 6 when a packet reaches a point of failure, the node adjacent to the failure, called the detecting node, is responsible for finding a backup configuration where the failed component is isolated. The detecting node marks the packet as belonging to this configuration, and forwards the packet. From the packet marking, all transit routers identify the packet with the selected backup configuration, and forward it to the node avoiding the failed component.

Step 7 Destinations is matched decompress the packet invoking decompression module explained in section 4.1.2

## 4.1 Compression Process

LZW is a dictionary based compression algorithm [14] LZW encodes data by referencing a dictionary. It can be used on any type of file, to encode a substring, only a single code number, corresponding to that substring's index in the dictionary, needs to be written to the output file. It generally performs best on files with repeated substrings, such as text files.

### 4.1.1**Algorithm: Compression**

```
string s
char ch
s = empty string;
while (there is still data to be read)
{
   ch = read a character;
   if (dictionary contains s+ch)
   {
            s = s+ch
   }
   else
   {
            encode s to output file;
            add s+ch to dictionary;
            s = ch
   }
}
encode s to output file;
```

LZW starts out with a dictionary of 256 characters and uses those as the "standard" character set. It then reads data 8 bits at a time and encodes the data as the number that represents its index in the dictionary. Every time it comes across a new substring, it adds it to the dictionary. Every time it comes across a substring it has already seen, it just reads in a new character and concatenates it with the current string to get a new substring.

The next time LZW revisits a substring, it will be encoded using a single number. It is necessary for the codes to be longer in bits than the characters (12 vs. 8 bits), but since many frequently occurring substrings will be replaced by a single code, in the long haul, compression is achieved.

### 4.1.2 **Algorithm: Decompression**

```
string entry
char ch
int precede, currcode
prevcode = read in a code
decode/output prevcode
while (there is still data to read)
{
   currcode = read in a code
   entry = translation of currcode from dictionary
   output entry
  ch = first char of entry
   add ((translation of prevcode)+ch) to dictionary
   prevcode = currcode
}
```

In Decompression process for LZW first it reads in an index (integer), looks up the index in the dictionary, and outputs the substring associated with the index. The first character of this substring is concatenated to the current working string. This new concatenation is added to the dictionary. The decoded string then becomes the current working string and the process repeats.

## 5. Experimental Results

In order to validate the proposed methodology and show its efficiency we present simulations using MATLAB. Evaluate the performance of compression algorithm in terms metric as follows:

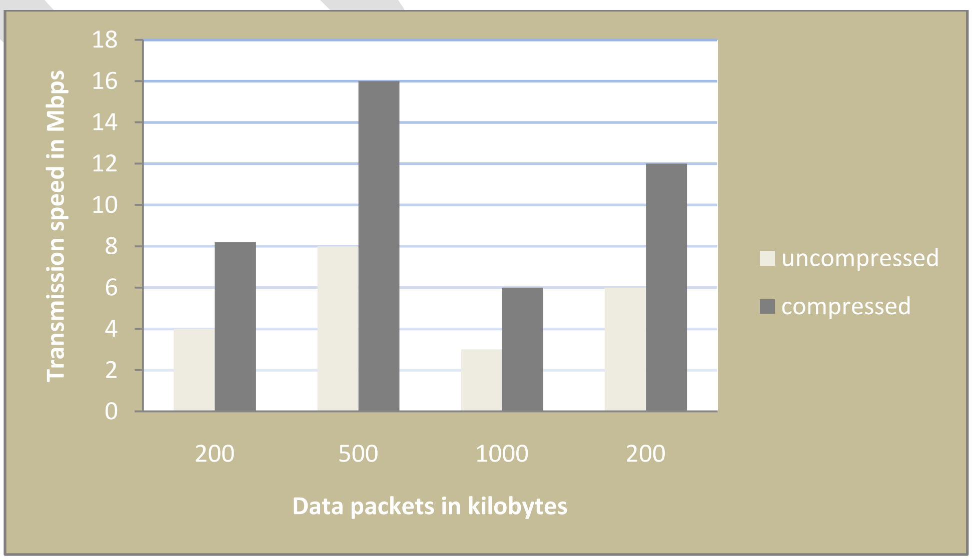


Fig 5.1 Performance Evaluation of compression and decompression of data packets.

In this experiment work, Transmission rate for different packet size is analyzed. Throughput is shown for both compressed and Decompressed of data packets. These results correspond to a channel rate Mbps, and packet size of kilobytes, Fig 5.1 shows the routing with compression success rate . Simulation results shows an impressive performance improvement of routing over standard multipath routing algorithm. As MRC uses both the min-hop and stability metrics in route discovery and backup configuration, where compression based MRC gives better utilization of bandwidth.

## 6. Conclusion

We have presented Multiple Routing Configurations as an approach to achieve fast recovery in IP networks. MRC is based on providing the routers with additional routing configurations, allowing them to forward packets along routes that avoid a failed component. MRC guarantees recovery from any single node or link failure in an arbitrary biconnected network. By calculating backup configurations in advance, and operating based on locally available information only, MRC can act promptly after failure discovery. This paper, proposes compression mechanism over the existing MRC algorithm which provides Bandwidth optimization using data compression algorithms to reduce the size of packets. A result shows packet transmission with compression and uncompression using MATLAB.

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