

## Adaptive Reset Time In FISH Network For BFF

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### Abstract

*In fundamental interconnecting structured homogeneous (FISH) network Bypass Flow-Splitting Forwarding (BFF) algorithm was proposed to forward the packets and make full use of available bandwidth of multipath according to routing oscillation phenomenon in Internet Service Provider (ISP) digital ecosystems (DES) [1]. Constant reset\_time considered caused under utilization of channel and thus increase in the packet loss ratio. By making adaptive reset\_time for link and refreshing the bandwidth availability with respect to it reduces the packet loss ratio or increases the utilization throughput of channel. With this proposed work we try to optimize the reset\_time by making it adaptive for refreshing the hash list for providing the bandwidth availability for each edge. It improves the throughput and reduces the latency.*

### 1. Introduction

A DIGITAL ecosystem is better as compared to client-server, peer-to-peer, grid, and web services. It is a newly networked architecture with collaborative environment [2][3][4][8][9][11]. Recent years have shown rapid development in underlying network technologies. Networks-based architectures research (NAR) has obtained a quick improvement and the link upgrade of backbone networks provides a core link foundation for NAR. NAR has considered the improvement of the interface hardware technology as an end link foundation. For deploying and implementing NAR the advent of programmable router (PR) has provided a platform foundation. With the infrastructure development of NAR collaboration is also the main challenge to the optimization of the digital ecosystem. The connectivity and traffic demands are not publicly available as no one wishes to share this kind of information for political or economic reasons. Development of BFF [1] was motivated by the lack of collaborations between digital ecosystems and appropriate use of PR improves negotiations and obtains a better collaboration performance in digital ecosystem. The drawbacks of single-path forwarding

(which can lead to routing oscillation) and fixed granularity forwarding (which can lead to inefficient usage of network bandwidth) were investigated and a bypass flow-splitting forwarding (BFF) algorithm was proposed and it was evaluated using NS2 simulation. Constant reset\_time considered causes the updating of available bandwidths for each edge to wait for finishing of the hashlist refreshing process. It has effect on utilization and increases the packet loss ratio. The hash list providing the available bandwidth for each edge is refreshed after reset\_time. So every edge has to wait for retrieving its available bandwidth till the reset\_time is over. But in this case if actual bandwidth is more than the computed bandwidth in hash list i. e. available bandwidth then there will be less utilization of edge. If the actual bandwidth is less than the available bandwidth in the hash list then more number of packets than the capacity will be sent and it will lead to loss of packets on the way increasing the packet loss ratio. It affects the throughput. We propose the idea of separate reset\_time for each edge. The available bandwidth of each edge will be refreshed after respective interval of reset\_time. The reset\_time is reduced if the required bandwidth is greater than current bandwidth and it is increased in opposite case..

### 2. Fish network model

The link-disjoint paths will become more than that in the past with the rapid increase both in bandwidth and links in recent years. These link-disjoint paths can be represented reasonably with the FISH network model. FISH networks are just the abstract model of ISP digital ecosystem and it is ubiquitous in many ISP networks today. Fig 1 shows the FISH network.

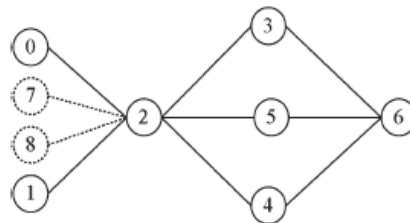


Fig 1 FISH Network Model

This topology has fish like shape. Nodes 0 and 1 are two hosts, and nodes 2, 3, 4, 5, and 6 are ISPs. In addition, node 2 can have other end users such as nodes 7 and 8. For different perspective, nodes 0 and 1 can also be ISPs. For example, node 1 may be an enterprise network, and it can have many customers itself. The destination address (DA), source address (SA), destination port (DP), and source port (SP) can consist of a flow. With the same DA, the other three can constitute eight combinations. The traditional single-path routing gets next-hop interface only through DA, which makes eight different flows forward to the same path. It is impossible for the single-path routing to provide differentiated services. With the same DA but different SP or DP under different application environment, the traditional single-path routing, such as open shortest path first (OSPF), makes flow-splitting characteristics impossible. With the rapid increase of Internet users, more users have more application requirements and the browsing habits of web users will produce more and more flows of the same destination..

### 3. Fixed granularity routing

It is found that the unbalanced traffic causes the routing oscillation which wastes too much processing time of the control plane. This routing oscillation also leads to the increase of delay and jitter in data plane [10]. As the traditional single path cannot split the traffic the available bandwidth cannot be used effectively and concurrently. A fixed forwarding granularity improves the ability of flow splitting as compared to single-path forwarding [5][6][7] but it cannot adapt to diverse applications. Digital ecosystem aims at creating a digital environment supporting the cooperation and development of open and adaptive technologies. Because a fixed forwarding granularity cannot adapt to the unbalanced traffic, BFF algorithm was proposed to provide an adaptive forwarding to make full use of available bandwidth of multiple paths.

### 4. BFF algorithm

Different digital ecosystems constitute a digital environment which is the infrastructure of a digital ecosystem. Digital ecosystem includes hardware, together with its associated software. For BFF the Mirror Processing Machine (MPM) and Programmable Router (PR) are the hardware implementation. BFF's three modules contribute to the software implementations.

**Classification Module:** It generates the hash index for transport layer packets. It checks if the index is existing in the hash list. If not then it makes new entry for it in the hash list.

**Statistics Module:** It calculates the available bandwidth of each path. Then it gets the new forwarding ratio and updates the feedback information for the bypass forwarding module. It computes and resets the hash list at a certain period in order to get a variable flow-splitting.

**Bypass Forwarding Module:** When a packet arrives at PR the instructions of the bypass forwarding module run. BFF combines cross-layer idea and revises the IP forwarding original code as the traditional IP protocol only operates on the IP header. BFF changes the strategy where traditional router chooses the next hop only through DA which cannot be achieved in a common router. CISCO and Juniper have opened their IOS and JUNOS. The advent of PR has provided the possibility for BFF bypass operations.

### 5. Mathematical Model

Let S be the system considered

$S = \{Ip, Op, Drt, RT, Crt, Rbw, Cbw, Is, Fs, Ss, E, N, F\}$

$Ip =$  Set of inputs.

$= \{N, E, RT, Rbw\}$

$N = \{n1, n2, \dots, nn\}$  Set of nodes

$E = \{e1, e2, e3, \dots, ee\}$  Set of Edges

$Crt =$  Current Reset Time for each edge.

$RT =$  Reset time of edge.  $\Rightarrow \text{compResetTime}(\text{edge}), (10\%Crt) < RT < (40\%Crt)$

$Drt =$  Default reset\_time for all edges  $= \text{compDrt}();$

$Rbw =$  Required bandwidth

$Cbw =$  Current bandwidth

$Op = \{\text{utilization}\}$

$Fs =$  Final State  $= \{Cbw, RT, \text{utilization}\}$

$F =$  set of functions

- resetResetTime()

Reset all edges with default reset time.

- compDrt()

Returns the default reset time to be set for all edges initially.

Avg End to End delay \* No of connections/users

If Bandwidth = 1 Mb

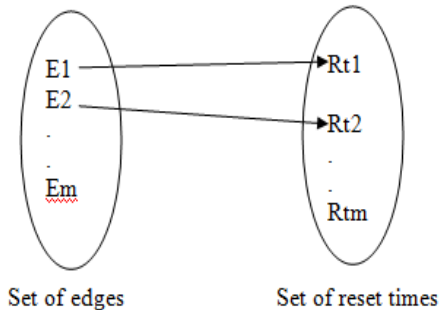
Packet interval = 10ms

Packet size = 500 bytes

End to End delay =  $(500 * 8)/1\text{Mb} = 14 \text{ ms}$

- resetResetTime(edge)

Reset single edge with its respective reset time.



- resetBW()

Resets bandwidth for all edges initially with required bandwidth.

- compResetTime()

temp\_Crt = Crt

RT = Crt + (0.02\*Crt)

If RT > (40 % Crt) then

RT = temp\_Crt

temp\_Crt = Crt

RT = Crt - (0.02\*Crt)

if RT < (10 % Crt) then

RT = temp\_Crt

- Utilization is computed with constant reset time and adaptive reset time

Trx = Receiving time, Ttx = Total transmission time,

Tidle = Total idle time.

$$U = \frac{T_{rx} + T_{tx}}{T_{rx} + T_{tx} + T_{idle}}$$

## 6. Proposed algorithm

1. For i = 1 to e Do
2. resetBW() // Reset bandwidth for all edges
3. End For
4. compDrt() // Compute default reset time
5. For I = 1 to e Do
6. resetResetTime() // Sets the Reset time for all edges with Drt
7. End For
8. While (true) do
9. if Rbw > Cbw
10. compResetTime() //Reduce resetTime
11. else
12. compResetTime() //Increase resetTime
13. End While

The structure considered is given below.

```
struct BFF {
```

```
    long hashIndex;
    long packetNum;
    long packetLenght;
    long startTime;
    long endTime;
    long aliveTime;
    int ratio;
```

```
};
```

Having constant reset\_time affects the bandwidth availability for edges which caused either underutilization of edge or increase in the packet loss ratio. The proposed idea of separate reset\_time for each edge adjusts the time required for updating bandwidth availability and thus reduces the underutilization of edge and improves its throughput and also helps in decreasing the packet loss ratio in FISH network model of digital ecosystem considered at ISP level. The performance of the system is observed in the form of latency and throughput mainly.

## 7. Implementation Details

The Adaptive Reset Time system is implemented using network simulator NS2.34. Fedora 14 operating system is used. A single desktop machine with 1GB of RAM, 40GB of hard disk and 2.4GHz of processor is sufficient for this implementation. As shown in architecture the network creation and traffic generation module creates a network similar to fundamental interconnecting structured homogeneous network. Links are assigned with bandwidths and packet sizes. The traffic generators are assigned to specific nodes. Type of traffic to be sent over the links is specified. It also specifies the schedule for starting and stopping the traffic generation. The details of traffic generated are stored into trace file. Reset time variation includes the routing module which specifies the adjacency matrix for storing the next hop information.

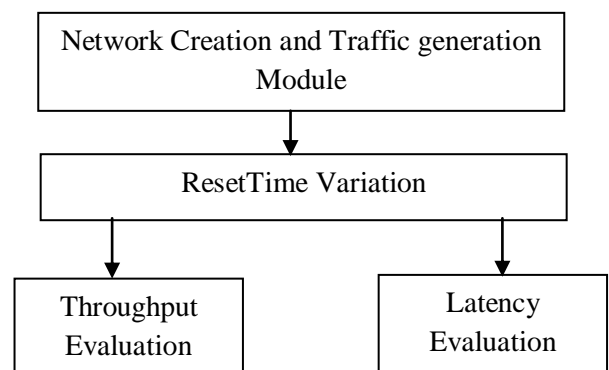


Fig. 2 Architecture of ART system

It mentions switchPath and granularity parameters. When switchPath is 1, based on the value of granularity the traffic is splitted on different links. When switchPath is 0, the flow is sent over only one link. It also specifies the compute\_routes() method which decides the route to send the traffic over. It also mentions source and destination nodes.

Throughput and latency evaluation contains the script for retrieving useful data from the trace file obtained from simulation. This data is used for comparing throughput and latency to analyze the performance of system.

### 8. Experimental results

An awk script is executed to obtain data from trace file. This data is used to get throughput and latency. Corresponding graphs are shown in figures. Table 1 shows the data obtained for throughput in both static reset time and adaptive reset time. As we can observe from graph there is improvement in throughput with the use of adaptive reset time in fundamental interconnecting structured homogeneous network.

Row Labels	BFF	EBFF	Grand Total
4	2.5	3.5	6
5	2.3	3.3	5.6
6	2.5	3.5	6
7	2.3	3.3	5.6
8	2.6	3.6	6.2
9	2.3	3.3	5.6
10	2.7	3.7	6.4
11	2.4	3.4	5.8
12	2.8	3.8	6.6
13	2.4	3.4	5.8
14	2.9	3.9	6.8
15	2.5	3.5	6
16	3	4	7
<b>Grand Total</b>	<b>33.2</b>	<b>46.2</b>	<b>79.4</b>

Table 1. Throughput data

Table 2 shows the data obtained for latency in both static reset time and adaptive reset time. As we can observe from graph there is improvement in latency

with the use of adaptive reset time in fundamental interconnecting structured homogeneous network.

Row Labels	BFF	EBFF	Grand Total
4	0.00965	0.00985	0.0195
5	0.00964	0.00983	0.01947
6	0.00963	0.00981	0.01944
7	0.00962	0.00979	0.01941
8	0.00961	0.00977	0.01938
9	0.0096	0.00975	0.01935
10	0.00959	0.00973	0.01932
11	0.00958	0.00971	0.01929
12	0.00957	0.00969	0.01926
13	0.00956	0.00967	0.01923
14	0.00955	0.00965	0.0192
15	0.00954	0.00963	0.01917
16	0.00953	0.00961	0.01914
<b>Grand Total</b>	<b>0.12467</b>	<b>0.12649</b>	<b>0.25116</b>

Table 2. Latency data

It can be seen from graph that there is improvement in latency.

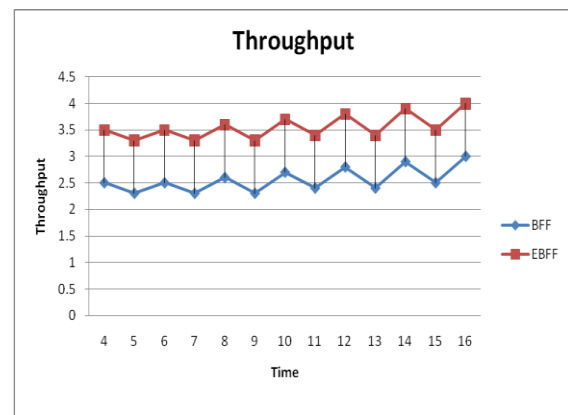


Fig. 2 Throughput vs. Time

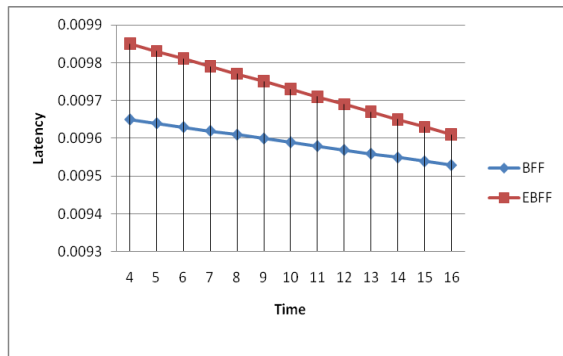


Fig. 3 Latency vs. Time

## 9. Conclusion

The proposed Adaptive Reset Time system provides variable reset\_time for links to get their available bandwidth in fundamental interconnecting structured homogeneous (FISH) network considered in Digital Ecosystem (DES). The Adaptive Reset Time system dynamically changes the reset\_time by considering the fixed interval. To measure the performance of proposed ART, it is implemented on a popular open source simulator, NS2.34. The ART decreases the latency time and improves the throughput in FISH network compared to default method of considering constant reset\_time.

## 10. References

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