# Topologic-aware Allocation Policies for Jellyfish

## ABSTRACT

## 1. INTRODUCTION

Jellyfish topology [1] has been recently proposed as a high bandwidth and low latency interconnect for large scale data centers and HPC systems. In opposite to recenctly proposed server-centric datacenter networks (DCN), jellyfish is an indirect (switch-centric) network in which the servers are connected to the switches. This network is a *degree-bounded* random regular graph (RRG) among the top-of-rack (ToR) switches, in which all the nodes have the same degree, are bidirectional and are connected randomly. RRGs also provide other desiderable properties for an interconnect such as low diameter, high connectivity among nodes and easy incremental expansion.

As stated in the original paper [1], routing in jellyfish is a challenge. Although jellyfish provides high connectivity among switches, classical routing policies are not able to exploit the path diversity offered. In that work the authors evaluated two well-known routing policies, shortest path (SP) and Equal-cost Multi-path (ECMP), assesing that the use of the shortest paths does not provide enough path diversity to utilize the full capacity of the network. This issue was solved using the K-Shortest Path (KSP) [2] routing policy that uses more paths at the cost of being longer. Although KSP perfoms well compared to SP and ECMP, the author in [3] showed that jellyfish has several features that make it ineffective. In particular they stated the possibly large number of source-destinations (SD) pairs that will share the same K shortest-paths and the random number of short paths between each pair of switches.

These works have studied jellyfish both theoretically, puting bounds to topological properties, and empirically evaluating the performance of several communication patterns. However none of them have consider the natural scenario in which this topology could be used: data centers or HPC centers where many applications run concurrently. To the best of our knowledge, there is no work devoted to evaluate the performance of such applications in this topology.

The assignemnt of resources to application has been widely studied in the context of HPC. Those works clearly differenciate three stages: selection of the application to be executed, allocation of the resources to that application and mapping of the taks that compose the application to the physical servers.

The objective of this work is the evaluation of the performance of these routing policies in multi-application scenarios.

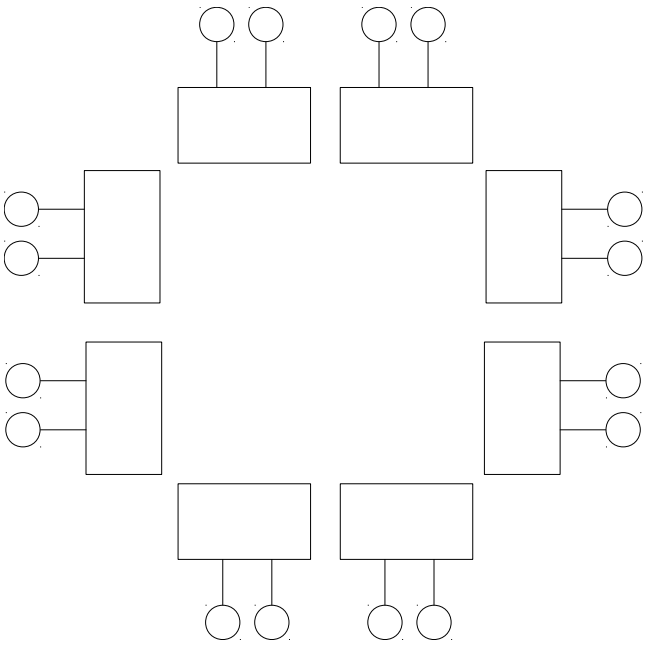

**Figure 1:**

The rest of the paper is organized as follow. Section 2

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## 2. BACKGROUND

In this section we describe thoroughly the jellyfish topology and give some definitions and properties that will be used in the rest of the paper. Furthermore, we describe the four routing policies developed for jellyfish asessing the pros and cons of each one of them.

### 2.1 Jellyfish topology

Jellyfish is a network topology in which the switches are connected randomly. We denote jellyfish as RRG(N,k,r) where N is the number of switches, k is the number of ports of the switches and r is the number of ports used to connect to other switches.

### 2.2 Routing policies

- Shortest Path (SP):
- Equal-Cost Multi-Path (ECMP):
- K-Shortest Path:
- Limited Length Spread K-shortest Path (LLKSR):

## 3. ALLOCATION IN JELLYFISH

When an application is submitted to be executed, the allocator is in charge of finding the appropiate set of resources to place it. There are many works that propose allocation policies for other topologies such as meshes, tori [4] [5], or fattrees [5] [6], but, to the best of our knowledge, not for jellyfish. Only in [3] the authors use some simple mono-application allocation policies without taking into account how these policies behave when multiple application run concurrently. In this section we describe and analize those policies adding a new version of one of them due to random structure of jellyfish.

In order to define the allocation policies we must first assign assign a node ordering to the servers and switches that compose the network. Due to the random structure of jellyfish, we first define order the switches and then, inside each switch, we order the server consecutively.

- Sequential: The tasks are assigned to the servers consecutively using the identity function.

$$\pi : T \rightarrow P\pi(t_i) = p_i \quad (1)$$

- Random: The tasks of the application are assigned to the servers uniformly at random.

$$\pi : T \rightarrow P\pi(t_i) = p_j where p_j is selected at random \quad (2)$$

- Random*: This is a special version of the previouly presented policies. In this case we select a switch uniformy at random and then we map (k-r) tasks to the servers direcctly connected to it.

$$\pi : T \rightarrow P\pi(t_i) = p_j where p_j is selected at random \quad (3)$$

## 4. LOCALITY AND CONTIGUITY IN JELLYFISH

## 5. EXPERIMENTAL SET-UP

### 5.1 Simulation environment

### 5.2 Communication patterns

### 5.3 Performance metrics

## 6. ANALYSIS OF THE RESULTS

## 7. CONCLUSIOSN ANS FUTURE WORK

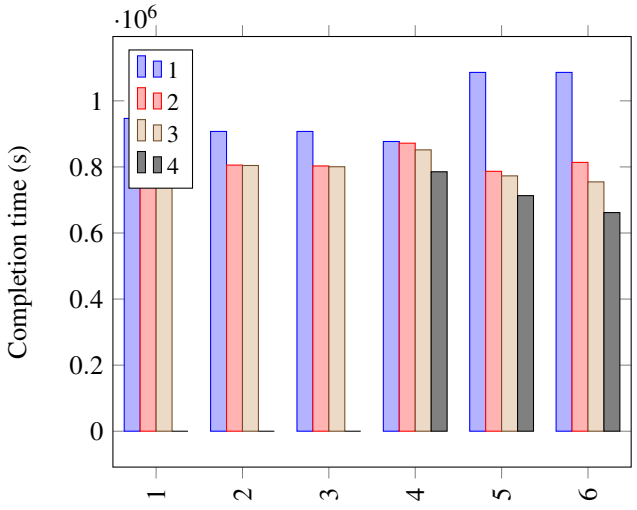


**Figure 2: Completion time in second employed to process three traffic patterns comparing.**

## 8. REFERENCES


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