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# An Innovative Topologies Based on Hypercube Network Interconnection

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**ABSTRACT**

**A parallel processing system's most crucial part is a network interconnection that links its processors. The hypercube topology has interesting features that make it a great option for parallel processing applications. This paper presents two innovative configurations of interconnection networks based on fractal Sierpinski and a hypercube. These are called the Sierpinski Triangle Topology (STT) and Sierpinski Carpet Topology (SCT). Compared to a hypercube, the Sierpinski Triangle topology (STT) noticed a significant decrease in the number of nodes and links as large networks grew. Hence, it is considered a great way to reduce costs because it uses fewer nodes and links. The average distance is also shorter, which is better. Despite it having a smaller bisection width and a higher degree than a hypercube by one. The Sierpinski Carpet Topology (SCT) has the advantage of having a high bisection width compared to a hypercube. That is preferable because it places a lower restriction on the difficulty of parallel algorithms. While the drawback of this topology is that it has a diameter and average distance more than a hypercube.**

**Keywords:** Fractal, Hypercube, Interconnection network, Sierpinski Carpet, Sierpinski Triangle.

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## I. Introduction

The multicore processor technology is the foundation of any high-performance computer system today. Multicore processors are used in everything from basic embedded systems to advanced server farms. The performance of such multicore systems is strongly dependent on the interconnection network that connects these cores [1]. The need to develop parallel processing in computers has become highly essential, leading the advent of newer interconnection networks to enable parallel processing. Interconnection networks, abbreviated as (Ins), may be classified as either dynamic or static [2].

Connections in a static network are permanent ties, but connections in a dynamic network may be built up on the fly according to the system's requirements. Point-to-point connections allow a direct link between a processor and other processors in static networks. It is also possible to classify it further according to the connectivity pattern as either having one dimension (1D), two dimensions (2D), or a hypercube (HC). In contrast, according to the interconnection methods, dynamic networks may be divided into bus-based and switch-based categories. Two subcategories may be applied to bus-based networks: single buses and multiple buses. According to the nature of the interconnection network, switch-based dynamic networks may be categcategoris as single-stage (SS), multistage (MS), or crossbar networks [1], [3]. The primary categories of interconnection networks are displayed in Fig. 1.

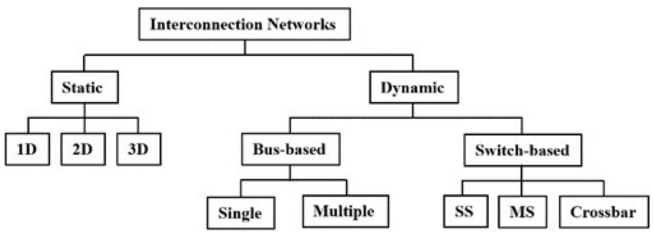


Fig. 1. Topology-based classification of interconnection networks [1].

Interconnection networks may also be divided into electrical and optoelectronic communication channels connecting processors. Hypercube, mesh, ring, tree, and other electronic connectivity networks are examples. Optical Chained-Cubic Tree (OCCT) and Optical Transpose Interconnection System (OTIS) are examples of optoelectronic interconnection networks. For OTIS, there are several architectures, including OTIS Hyper Hexa-Cell (OHHC), OTIS-Hypercube, OTIS Mesh, and many more [4].

The interconnection networks compare in terms of several topological properties, the most important of which are [5], [6]:

1) The diameter of a network is the length of the shortest path between a source and a destination.
2) The degree of a node reveals how many nodes directly connect to it.
3) The area cost of a network is determined by the diameter and the degree.
4) The average distance is the sum of the distances of all nodes from a certain node (the source) divided by the number of nodes. In a computer network, the average