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GENERALIZED SHUFFLE-EXCHANGE NETWORKS: COMBINATORIAL AND FAULT TOLERANT PROPERTIES

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Abstract. Shuffle-exchange networks have been proposed as an attractive choice for interconnection networks. They have constant node degree and sublogarithmic diameter. Several researchers have studied various combinatorial and interconnection properties of them. In this paper, we generalize shuffle-exchange networks and define a new class of networks, called generalized shuffle-exchange network and denoted as $GS(k, N)$, where k is the node degree and N is the number of nodes. We study various combinatorial and interconnection properties of $GS(k, N)$ such as diameter, wide-diameter, connectivity, embedding property, and self-routing property. We also study fault tolerant properties of shuffle-exchange networks and propose a modified version of shuffle-exchange networks that improve some of the properties of shuffle-exchange networks.
Keywords. Shuffle-Exchange Network, Generalized Shuffle-Exchange Network, Combinatorial Property, Fault-tolerant Properties, Wide-Diameter, Fault-Diameter, Rabin Number.

1 Introduction

Experience on using parallel computers to solve various problems in the past decades indicates that the ultimate utilization of parallel computers is heavily dependent on the topology of the interconnection network that connects the processors. Due to the advent of VLSI and fiber optic technology, it is not only feasible but also practical to design large scale communication networks employing hundreds or thousands of computer nodes interconnected by routers and switches. Interconnection networks play an important role in parallel architecture, communication networks and VLSI design [15;19;23].

A number of networks have been proposed including linear array and ring [12], tree [23], hypercubes [8], de Bruijn networks [15;21], shuffle-exchange networks [15;22], butterfly network [13], cube-connected cycles [18], star networks [1], and some hypercube-based networks [8]. Architectures based on these networks have been built in industry, research, laboratories and academic institutions. We have defined a new class of networks $GS(k, N)$, called generalized shuffle-exchange networks, which generalizes n-dimensional k-ary