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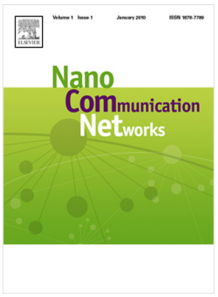

Circuit switching with Quantum-Dot Cellular Automata

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Circuit Switching With Quantum-Dot Cellular Automata

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***Abstract*—Circuit switched network is a fundamental component to transmit the input signal among different users within a distributed communication networks. This paper demonstrates the design of a novel fault-tolerant circuit switched network based on Quantum-Dot Cellular Automata (QCA). The design is achieved in a single layer. To design this communication network, a novel crossbar switch is proposed in this paper. The proposed circuit switched network has the major building blocks as multiplexer, demultiplexer and crossbar switch. Stuck-at-fault at the inputs as well as at the outputs is explored to design fault free circuit for crossbar switch. How the communication through crossbar switch as well as circuit switched network is disrupted due to control signal, is also demonstrated. All those proposed QCA layouts have low energy dissipation, which is shown by exploring the dissipated energy by the layouts. The designs are evaluated in terms of area, latency and logic gates. The designs are verified through matching up the results with the truth tables.**

***Index Terms*— QCA, Crossbar switch, Circuit switched network, Communication, Energy dissipation, Stuck-at-fault.**

I. INTRODUCTION

IN a nano-device, power loss and device density are becoming the most challenging issues. As the device densities are in sub-micron level, the complexity of the device becomes higher. This causes the elevated power consumption in a circuit. Thus, a low power device with high device density is required. Amongst the most promising device alternative to CMOS, quantum-dot cellular automata (QCA) may be the best choice [1-3]. QCA takes care of size, operating speed and power consumption [4-7]. QCA device is a transistor-less device. It has very fast operating speed, high device density with low power consumption [8-12]. Electrons are the main element of QCA to perform various computations and propagation of information [13-16]. In QCA, the mutual relation between electrons is responsible for storing and processing of information [17-21]. In 1993, the idea of QCA device was first initiated by Lent et al. [1]. Next, in 1997 the development has been achieved [2]. Finally, in the year of 2014, Dilabio and his co-workers have fabricated QCA device cell successfully [22]. The inherent capabilities of QCA acts as the motivation to design QCA based architecture for future Nanocommunication. At present, Nanocommunication based on QCA device is a growing area of research and few works are accounted in this area. Circuit switched network [23] is an essential component to transmit the input signal among different users within a distributed communication networks. The work reported in this paper deals with a novel design of circuit switched network based on QCA. The design is achieved in a single layer. To design this communication network, a novel crossbar switch is proposed in this paper. The proposed circuit switched network has the major building blocks as multiplexer, demultiplexer and crossbar switch. The implementation and verification of proposed circuit switched network is achieved on QCA Designer-2.0.3, the tool to simulate QCA circuits [24]. Wire crossing in QCA is important to perform systematic design of logic circuits. Wire crossing also poses a barrier higher than QCA wire length in the architecture. Single layer designs of circuits with QCA are possible because of the capability to form co-planner crossovers. The fabrication feasibility of multilayer QCA cells is still in a questionable position and almost impossible to fabricate. Moreover, fabrication of multilayer QCA cells requires accurate alignment. On the other hand, single layer design with