Design and Implementation of Low Power Packet Switched Network

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Abstract— this paper uses Pipelined Packet Switching (PPS) approach for reducing power consumption during data transmission. The topology used here is 3- stage clos topology. Packet switching can be seen as a solution that tries to combine the advantages of message and circuit switching and to minimize the disadvantages of both. A pipeline is a way of making concurrent computations, which increases the speed of the overall execution, compared to a serial computation. In a pipeline, all computational logic blocks, which have something to do, make computations at the same time. .The scheduling network unblocks one or more rendering pipelines other than the first rendering pipeline in response to receiving the resume token.

Keywords: Data transmission with low power consumption, Pipelined Packet Switching (PPS), Permutation Network (PN), low noise with high throughput.

I. INTRODUCTION

Permutation network includes a traffic pattern in which each input sends traffic to exactly one output ad each output receives traffic from exactly one input. Application-aware routing includes traffic pattern which improves the circuit performance. Another application approach is used to avoid cycles in the channel dependency graph. It includes two routing problems: specialized optimal routing problem and combined optimal routing problem [8]. Specialized optimal routing includes single traffic pattern whereas combined optimal routing has own traffic pattern.

In wireless technology, high level modelling is exploited to drive the Network-On-Chip (NOC) optimization. It includes two decoding algorithm: turbo code decoding algorithm and Low-Density-Parity-Check (LDPC) code decoding algorithm. Turbo code decoding algorithm is based on iterative exchange usually referred as Soft-In-Soft-Out (SISO) units [4].Both turbo and LDPC decoders employ parallel architecture for achieving high throughput. It provides complex routing algorithm to reduce the First-In-First-Out (FIFO) input depth.

The major factor which directly affects the performance of the circuit is the switching noise. Switching noise generation is minimized by two logics: Current Steering Logic (CSL) and Current-Balanced Logic (CBL).A new logic family called Current-Steering CMOS (CS-CMOS) is obtained to provide better speed than CSL and CBL.CS-CMOS logic can be studied with the help of: static transfer characteristics, dynamic characteristics, current supply spikes, CS-CMOS gates and decimation filter.

Power and area are the most important factors to be considered during the design of low power permutation network. In the early days of networking, networks were small collections of computers linked together for the purposes of sharing information and expensive peripherals. Early networks were sometimes configured as peer-to-peer networks so that the Computers communicate with and provide services to their "peers" and all communication occurs on the same network segment. But now, the improvement in the switching and routing process provides communication on the different network segment.

II. APPROACHES USED

This approach mainly depends on three factors. They are

1) Switching techniques
2) Topology
3) Routing algorithm

A. Switching techniques

In large networks there might be multiple paths linking sender and receiver. Information may be switched as it travels through various communication channels. There are three typical switching techniques available for digital traffic.

- Circuit Switching
- Message Switching
- Packet Switching

1) Circuit Switching

Circuit switching is a technique that directly connects the sender and the receiver in an unbroken path. Telephone switching equipment, for example, establishes a path that connects the caller's telephone to the receiver's telephone by making a physical connection. With this type of switching technique, once a connection is established, a dedicated path exists between both ends until the connection is terminated (Fig 1).Routing decisions must be made when the circuit is first established, but there are no decisions made after that time.

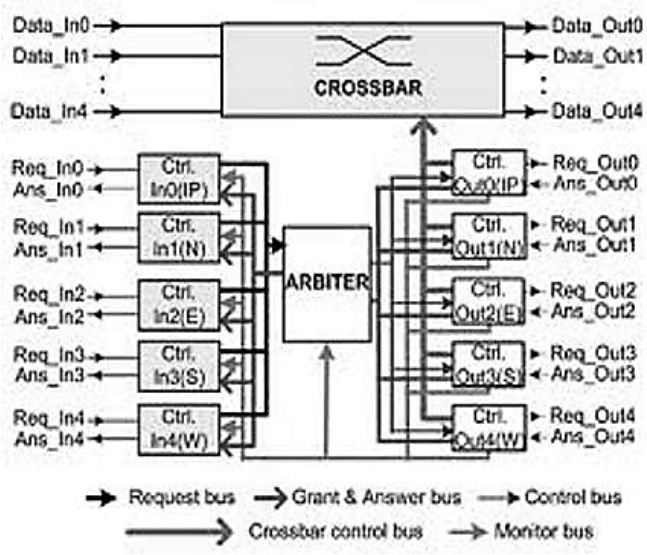

Fig. 1: Common circuit switching approach.

Disadvantages:

- Long wait to establish a connection, (10 seconds, more on long- distance or international calls.) during which no data can be transmitted.
- More expensive than any other switching techniques, because a dedicated path is required for each connection.
- Inefficient use of the communication channel, because the channel is not used when the connected systems are not using it.

2) Message Switching

With message switching there is no need to establish a dedicated path between two stations. When a station sends a message, the destination address is appended to the message. The message is then transmitted through the network, in its entirety, from node to node. Each node receives the entire message, stores it in its entirety on disk, and then transmits the message to the next node(Fig 2).This type of network is called a store-and-forward network.

Advantages:

- Channel efficiency can be greater compared to circuit-switched systems, because more devices are sharing the channel.
- Traffic congestion can be reduced, because messages may be temporarily stored in route.

Disadvantages:

- Message switching is not compatible with interactive applications.
- Store-and-forward devices are expensive, because they must have large disks to hold potentially long messages.

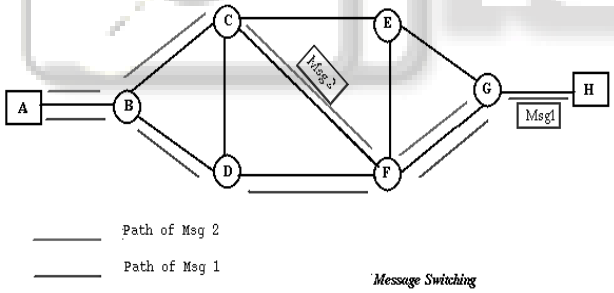

Fig. 2: Message switching

3) Packet Switching

There are two methods of packet switching: Datagram and virtual circuit. In both packet switching methods, a message is broken into small parts, called packets. Each packet is tagged with appropriate source and destination addresses. Since packets have a strictly defined maximum length, they can be stored in main memory instead of disk, (Fig 3) therefore access delay and cost are minimize. Also the transmission speeds, between nodes, are optimized. With current technology, packets are generally accepted onto the network on a first-come, first-served basis. If the network becomes overloaded, packets are delayed or discarded (``dropped").

The difference between virtual circuit and datagram approaches:

- With virtual circuit, the node does not need to make a routing decision for each packet.
- It is made only once for all packets using that virtual circuit.

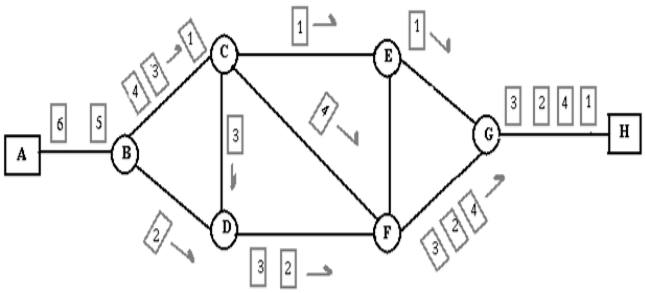

Fig. 3: Packet switching

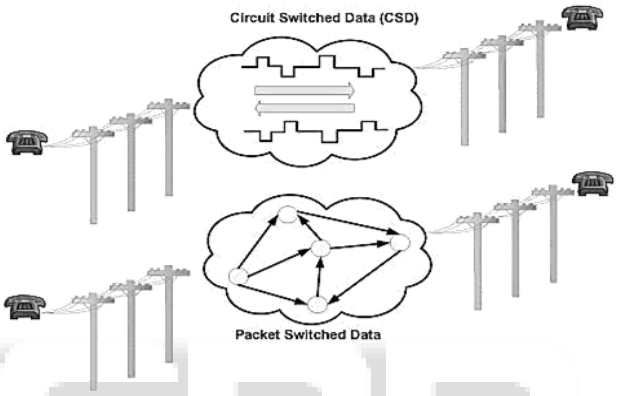

Fig. 4: Circuit switching compared to packet switching

Advantages:

- Packet switching is cost effective, because switching devices do not need massive amount of secondary storage.
- Packet switching offers improved delay characteristics; because there are no long messages in the queue (maximum packet size is fixed).
- Packet can be rerouted if there is any problem, such as, busy or disabled links.
- The advantage of packet switching is that many network users can share the same channel at the same time.
- Packet switching can maximize link efficiency by making optimal use of link bandwidth.

Because of its performance, this type of switching is mostly used compared to other switching techniques.

B. Topology

Regarding the topology, regular direct topologies, such as mesh and torus are intuitively feasible for physical layout in a 2-chip. On the contrary, the high wiring irregularity and the large router radix of indirect topologies such as Benes or Butterfly pose a challenge for physical implementation. However, an arbitrary permutation pattern with its intensive load on individual source-destination pairs stresses the regular topologies and that may lead to throughput degradation. In fact, indirect multistage topologies are preferred for on-chip traffic-permutation intensive applications.The topology used for efficient circuit

switching is three stage clos topology.The topology used here is "3-stage clos". It provides 0.13µm CMOS technology with low power consumption packet data transmission. This topology provides better throughput with less area requirements (Fig 5).

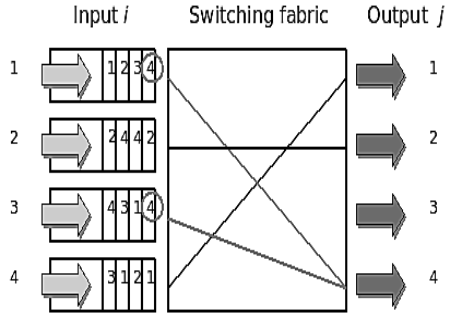

Fig. 5: Packet switching with 3-stage clos topology

Clos network is a family of multistage networks applied to build scalable commercial multiprocessors with thousands of nodes in macro systems. The choice of the three-stage Clos network with a modest number of middle-stage switches is to minimize implementation cost, whereas it still enables a rearrange able property for the network.

C. Routing algorithm

Routing is the process that a router uses to forward packets toward the destination network. A router makes decisions based upon the destination IP address of a packet. In order to make the correct decisions, routers must learn the direction to remote networks (Fig 6). Two types of routing are used: static and dynamic routing [1].When routers use dynamic routing, this information is learned from other routers. When static routing is used, a network administrator configures information about remote networks manually.

Protocols that can carry Network layer information. For example, Transmission Control protocol/Internet Protocol (TCP/IP). Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/SPX).When routers use dynamic routing; this information is learned from other routers. Dynamic routing uses the route that a routing protocol adjusts automatically for traffic or topology changes. When static routing is used, a network administrator configures information about remote networks manually. Static router uses the programmed route that a network administrator enters into the router.

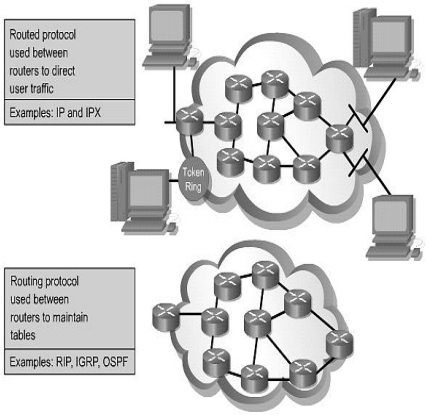

Fig. 6: Routing method

The routing process is achieved by routing protocols (Fig 6):

- RIP (one hop count, how many networks a packet crosses), Networks are treated equally
- BGP (depend on the policy, set by administrator)
- OSPF (TOS, minimize delay, maximize throughput)

INTERIOR GATEWAY ROUTING PROTOCOL(IGRP)

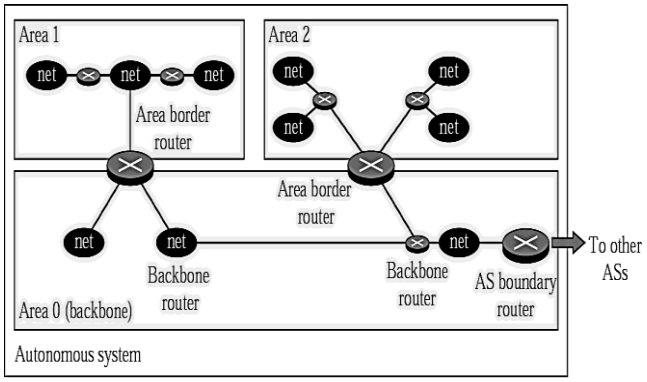

Fig. 7: OPSF Operation

Open Shortest Path First (OSPF) is a nonproprietary link-state routing protocol. The key characteristics of OSPF are as follows:

- It is a link-state routing protocol.
- Open standard routing protocol described in RFC 2328.
- Uses the SPF algorithm to calculate the lowest cost to a destination.
- Routing updates are flooded as topology changes occur.

It uses IP and has a value in the IP Header (8 bit protocol field). Special routers (autonomous system boundary routers) or backbone routers are responsible to dissipate information about other AS into the current system (Fig 7). It divides an AS into areas. Metric based on type of service: Minimum delay (rtt), maximum throughput, reliability, etc.

III. RESULT AND DISCUSSION

LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages, where instructions determine program execution, LabVIEW uses dataflow programming, where the flow of data determines execution. In LabVIEW, you build a user interface by using a set of tools and objects. The user interface is known as the front panel. You then add code using Graphical representations of functions to control the front panel objects. The block diagram contains this code. In some ways, the block diagram resembles a flowchart. Lab VIEW also has built-in features for connecting your application to the Web using the Lab VIEW Web Server and software standards such as TCP/IP networking and ActiveX. Using LabVIEW, you can create test and measurement, data acquisition, instrument control, data logging, measurement analysis, and report generation applications. You also can create stand-alone executable and shared libraries, like DLLs, because LabVIEW is a true 32-bit compiler.

This course prepares you to do the following:

- Understand the VI (Virtual Instrument) development process.

- Understand some common VI programming architectures.
- Design effective user interfaces (front panels).
- Use data management techniques in VI.
- Use advanced file I/O techniques.

Improve memory usage and performance of your VI. LabVIEW programs are called virtual instruments (VIs). VIs contain three main components—the front panel, the block diagram, and the icon and connector pane. The front panel is the user interface of the VI. The following example shows a front panel. The front panel with controls and indicators, which are the interactive input and output terminals of the VI, respectively. Controls are knobs, push buttons, dials, and other input devices. Indicators are graphs, LEDs, and other displays. Controls simulate instrument input devices and supply data to the block diagram of the VI. Indicators simulate instrument output devices and display data the block diagram acquires or generates. The menus at the top of a VI window contain items common to other applications, such as Open, Save, Copy, and Paste, and other items specific to LabVIEW. LabVIEW has graphical, floating palettes to help you create and run VIs.

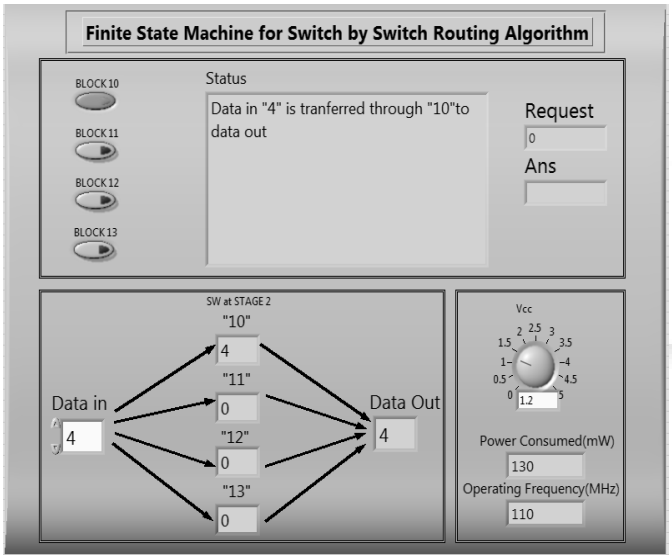

Fig. 8: Circuit Switched Simulation output.

OPERATION:

The simulation starts by giving input to data in and the power supply is set to 1.2 V. The switch used is 4×4.The operation includes the following process:

- The data given in data in is passed to the switch stage.
- The data verifies the free path for the data transmission.
- It chooses the path 10.
- Finally data in "4" is transferred through 10 to data out.
- The corresponding power consumption (mW) and operating frequency (MHz) are displayed.

Packet Switched data consumes power of about 90 mW during transmission. It can be operated for various voltages and the corresponding operating frequency is measured.

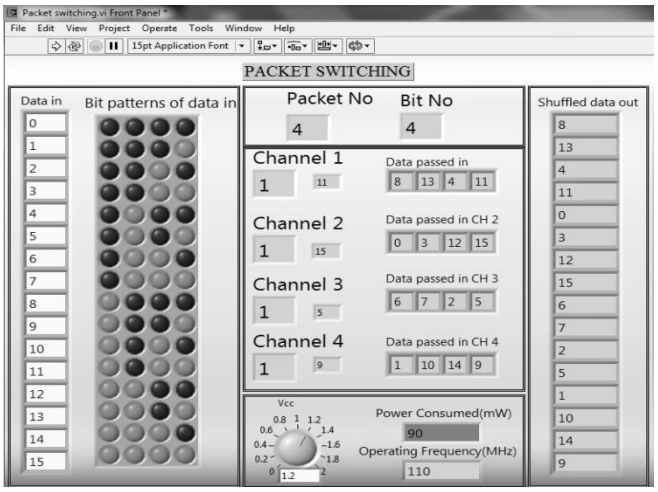

Fig. 9: Packet Switched Simulation Output.

IV. CONCLUSION

Packet switching is preferred than other techniques because it pack the group of data as a single packet and transmit it from server to receiver. This technique provides operation in FIFO manner. As the result, it can share the same channel at same time. It also reduces the power up to 10% (approximately) of original power consumed. It increases the gain and efficiency. The future work includes the improvement of quality during switching. It also includes the error free packet data transmission. Reduction of complexity may also be included.

V. REFERENCES

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