Applied Mechanics and Materials
ISSN: 1662-7482, Vol. 340, pp 213-217
doi:10.4028/www.scientific.net/AMM.340.213

Online: 2013-07-15

Analysis of Network-on-chip Structure in Green Manufacturing

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Keywords: Network-on-chip Structure; Application; Advantages and Disadvantages

Abstract. Network-on-chip (NoC) is a new communication way proposed by technical personnel in the long process of research, and it has efficiently gotten rid of the disadvantages of the early communication network through the application of the multi-core technology. In this paper, the composition of network-on-chip structure is first analyzed, and then the advantages and disadvantages of the network-on-chip structure are summarized, and finally the effective solutions for the scientific application of NoC are proposed. Hopefully, this paper can play a help in the follow-up studies.

Introduction

Along with the continuous increase of the information amount interacted by people, the communication way established in the previous time has been unable to meet the requirements of the mass-flow data transmission, and the transmission problems can be fundamentally solved only through the formulation of new communication network. Network-on-chip (NoC) is a new communication way proposed by technical personnel in the long process of research, and it has efficiently gotten rid of the disadvantages of the early communication network through the application of the multi-core technology. Now, the advantages and disadvantages of the network-on-chip structure application are analyzed, and also related improvement measures are proposed.

Analysis on the composition of network-on-chip structure

Information interaction use is a common operation in the life and work of people and also the orderly information transmission can be implemented with the aid of the communication network so that the stability of information alternate use is ensured. Under the premise of the popularization and application of electronic equipment, network-on-chip begins to play a superior signal transmission function in electronic circuit communication mode by relying on its unique function advantages. NoC not only covers the service area of the whole communication network, and also plays a very good role in the backend operations of network, promoting electronic equipment to carry out commands and tasks in the limited time. The structure of NoC is as shown in figure 1.

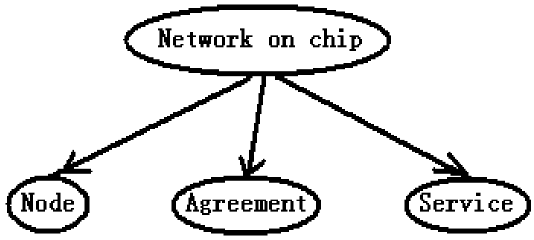

Figure 1: Network on chip

Network nodes

In NoC, the commonly applied and also the most suitable network structure is the packet-switched direct network, and thus the mutual correlation among different nodes is needed for implementing signal transmission. The form of multi-node's mutual communication is used in NoC, and each node is connected to the adjacent node through a two-way channel. The network connection of NoC is heterogeneous and needs to connect different processing units and storage components, and also the distribution of communication traffic is not uniform. Such a characteristic makes the range of communication transmission wider, and also the continuous operation of multipoint transmission is realized.

Network protocol

In operation stage, any network has to operate in accordance with protocol, and the security of data transmission can be ensured only through the limited controls from network protocol. Usually, NoC communication protocol is much more complicated than bus protocol, and NoC protocol covers diversified contents and has basically integrated the flows of data transmission together. To facilitate the expansion, a layered network protocol is often used for measuring NoC action effect from different perspectives, so specific functions and interface are provided for each layer of protocol.

Network service

Keeping a superior quality of service is indispensable for the operation of NoC structure, and functional security can be provided for users only if service mode is developed. In the NoC routing decisions, the quality of service can be provided so as to ensure the network bandwidth or delay of key components, and the best routing strategy is used for the non-ensured communication. In addition, the links between components become unreliable because of interference and voltage drop problems; to ensure a reliable data transmission, data is required to retransmit once data errors occur, and then the quality of service is ensured by NoC through flow control mechanism.

Advantages and disadvantages of network-on-chip application

In order to change the disadvantages of the traditional signal network, new network is chosen for multi-functional electronic equipment as support in the use stage. This is because NoC owns the advantages of many aspects in control function and has begun to become the mainstream trend of electronic signal transmission. According to user feedback, both advantages and disadvantages are possessed by NoC, and knowing well this standard plays a corresponding guiding role in new communication network operation.

Advantages

Fundamentally speaking, NoC is an improvement design for the original communication network, and uses a single chip as the focal point of the system, so that the secured transmission of data signal is realized. The advantages of NoC application can be reflected as follows.

(1) High bandwidth

Signal transmission operation is implemented by electronic equipment with the aid of computer network, and the efficiency of information transfer is decided by the network operation level. NoC possesses a high bandwidth condition and provides users with a broader signal transmission channel, as shown in figure 2. For example, higher bandwidth can be acquired through concurrence and non-blocking switching, making it easy for users to transfer information.

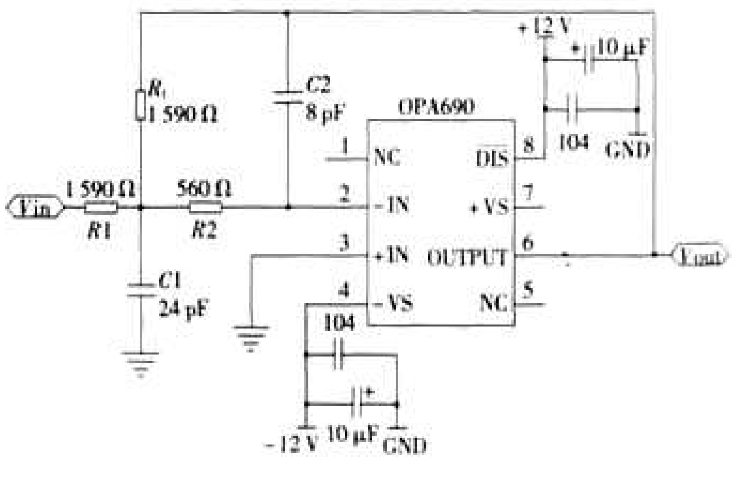

Figure 2: Bandwidth amplifier

(2) Optimal efficiency

The traditional communication network is relatively concentrated in the link structure, so that communication signal transmission area is relatively concentrated and also link work carries a great transmission load, and subsequently the action efficiency of the whole link is affected. In new NoC, a higher link utilization rate is acquired with the packet switching mode, so that the disadvantages of the traditional network operation are solved.

(3) Less energy consumption

In the transmission of energy consumption, reliable transmission modes can be acquired by NoC through layered protocols. For example, low power consumption is acquired by point-to-point transmission, and also the coefficient of energy consumption in the communication line transmission is reduced. When more complicated signal transfer flow is encountered, NoC automatically becomes a modular and updatable structure which is globally asynchronous or quasi-synchronous.

Disadvantages

After NoC is used for a long time, the composition of the communication network structure is further known by users, and then the due related disadvantages of NoC are found. The disadvantages of NoC mainly include the following several aspects.

(1) Circuit problem

Because a distributed network structure is chosen for NoC, network line connection area is added in this scheme, and thus a lot of inconvenience is brought to line connection and control.

(2) Time problem

The information processing steps in NoC are more meticulous, directly making network signal response time long. Worse, time delay problem may appear.

(3) Compatibility problem

Specifically, the structure layout of NoC has been greatly improved in comparison with that of the traditional network, and also its data processing functions have been relatively better. However, there is a significant compatibility problem in the actual transmission process (i.e. the compatibility of the new network with the original IP core interface and protocol), and the buffer and adding logics have resulted in the increase of power consumption.

Effective solutions for the scientific application of NoC

In view of the use value of NoC in communication transmission, the communication operators in the new period have to deeply compare and analyze the advantages and disadvantages of NoC and avoid the adverse effects caused by the disadvantages as much as possible under the premise of using network transmission advantages. The author thinks that the assessment on the communication performances of NoC is necessary to make well for the scientific application of NoC, and two solutions (stochastic assessment and actual assessment) can be used.

Stochastic assessment

(1) Assessment way

Stochastic assessment is a test mode through extracting samples so as to verify if there are disadvantages of NoC in use functions, and also improvement solutions can be made according to the requirements of user communication transmission. Stochastic assessment is applicable to theoretical studies in most cases and often used as an evaluation way of NoC data model analysis, as shown in figure 3.

(2) Project example

Because stochastic assessment is only limited to theoretical researches, the network problems reflected from superficial data are not significant, and attention is necessarily paid to the layout and design of network structure in the actual analysis. For example, the throughput rate of NoC is assessed through the stochastic assessment way, and also transmission rate can be tested for the whole data communication system, so as to ensure the normal work flow of network protocol. Usually, the communication protocol of NoC is much more complicated than bus protocol, and NoC protocol covers diversified contents and has basically integrated the flows of data transmission together. To facilitate the expansion, a layered network protocol is often used for measuring NoC action effect from different perspectives, so specific functions and interface are provided for each layer of protocol.

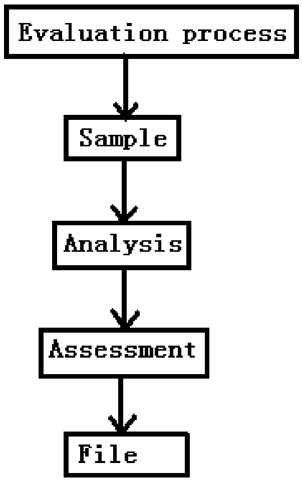

Figure 3: Stochastic assessment

Actual assessment

(1) Assessment way

Compared with the above assessment method, actual assessment is very practical in the results of analyzing the advantages and disadvantages of NoC, and this is an assessment operation implemented according to the real office use results of users. For example, assessment personnel make a preliminary assessment on the working efficiency of all the network nodes in combination with the data indexes acquired by NoC monitoring, and finally provide an objective assessment from a wide range. In this assessment way, the advantages and disadvantages of NoC are truly reflected, so guidance is provided for practical operation.

(2) Project example

In NoC, high importance is attached to the analysis of link utilization indexes in use. According to this analysis result, data communication solutions can be adjusted in time. Keeping a superior quality of service is indispensable for the operation of NoC structure, and functional security can be provided for users only if service mode is developed. In the NoC routing decisions, the quality of service can be provided so as to ensure the network bandwidth or delay of key components, and the best routing strategy is used for the non-ensured communication. Actual assessment method can provide a control for the operation of physical lines; to ensure the reliable data transmission, the service quality of link is ensured by NoC through flow control mechanism.

Conclusion

In short, NoC is a new communication transmission way, and has provided users and electronic equipment with a more superior control platform because an optimized improvement is implemented for its structure layout. The promotion and use cycle of NoC is very short; NoC still has obvious disadvantages in the stage of display and application. Therefore, it is necessary to lay an emphasis on the potential hidden troubles caused by the disadvantages of NoC under the premise of ensuring the full play of the network use advantages. Through a comprehensive assessment on NoC, the efficient play of the communication mode functions can be coordinated well.

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