A novel structure to achieve broadcastable IJTAG network

Feilong Pan[1,2], Minqiang Peng[1,2], Lei Yang[1,2], Keqing Ouyang[1,2], Guohua Zhou[1,2] ,Pawini Mahajan[3]
[1]State Key Laboratory of Mobile Network and Mobile Multimedia Technology
[2]Sanechips Technology Co.,Ltd.
[3]Synopsys, Inc.

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Agenda

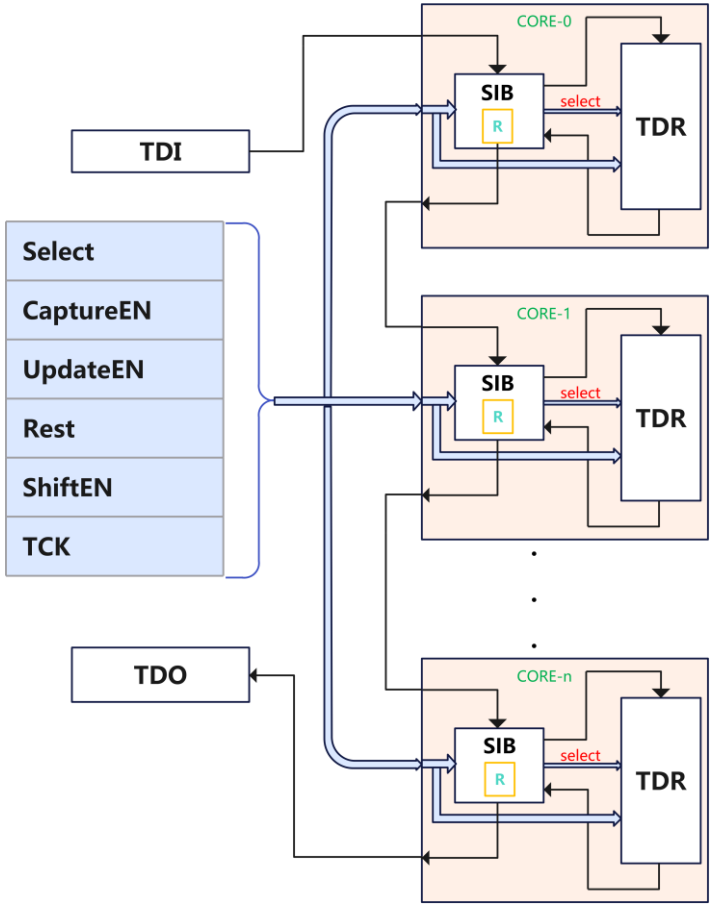
- *Abstract*
- *Motivation*
- *Main idea*
- *Usage & Benefits*
- *Summary*

Abstract

- The increasing area and complexity for system-on-a-chip (SOC) designs, leading to highly demand and efficiency for chip testing. In order to achieve better controllability and observability, IEEE 1687 standard (IJTAG) is widely integrated in designs recently. Most processor chips are large-scale, and there are many duplicated cores. The configurations are same for most cases during testing. The test time will reduce significantly if the IJTAG network can be broadcast controlled. However, the TDR can not be broadcast controlled for IJTAG network, this means that the same data needs to be shifted multiple times and more shift cycles to every TDR even if the configuration of each TDR is the same. This disadvantage seriously affected the efficiency of configuration.
- In this paper, we propose a broadcastable IJTAG network.
- Two new broadcast signals BroadCast_TDI and BroadCast_Select are used to control SIBs. The BroadCast_TDI signal connects with TDI, it acts as data input when the IJTAG is in broadcast mode. The BroadCast_Select signal is controlled by a dedicate instruction. The IJTAG network will switch to broadcast mode if the BroadCast_Select signal asserted. In the broadcast mode, TDR can be configurated broadcastly.
- The configuration cycles of TDR reduced a lot using broadcast IJTAG network and the efficiency of configuration is improved significantly.

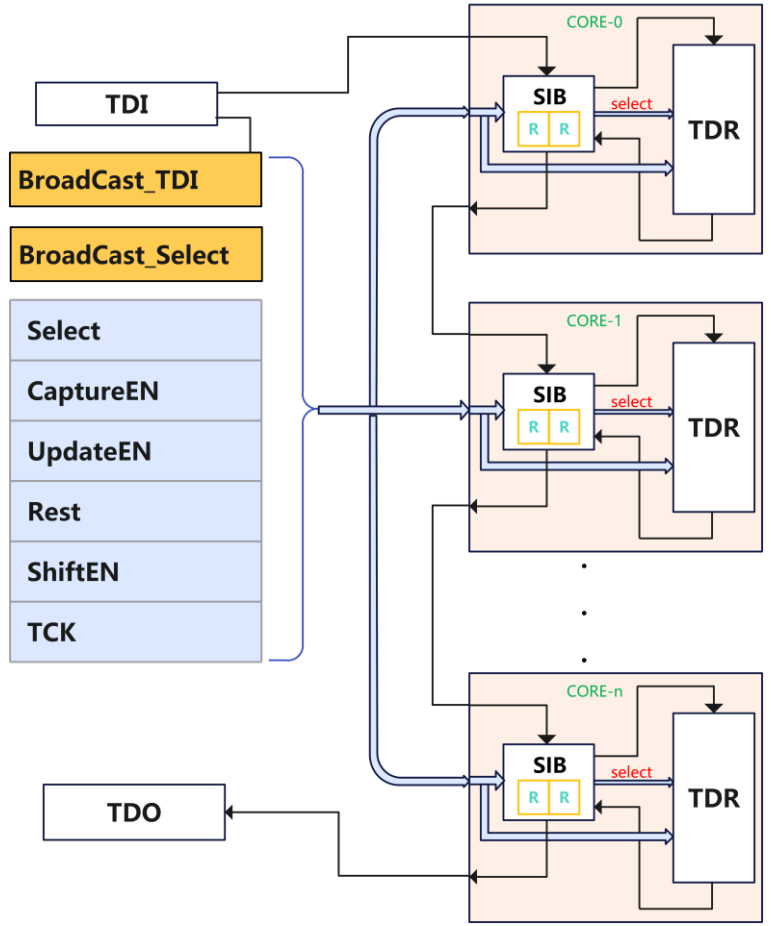
Motivation

- The increasing area and complexity for system-on-chip (SOC) designs, leading to highly demand and efficiency for chip testing. In order to achieve better controllability and observability, IEEE 1687 standard (IJTAG) is widely integrated in designs recently.
- As shown in the right figure, IJTAG is a serial access, hierarchical scan network. As an important componnet of IJTAG, Segment Insertion Block (SIB) acts as a switch for every section or Test Data Register (TDR). If the TDR of CORE-0 needs to be configured, the SIB of CORE-0 should be‘open’first, the scan data path is: TDI -> CORE-0 SIB -> CORE-0 TDR -> ... -> TDO. The SIB is ‘closed’ and TDR is bypassed if there is no need to configurate.
- Most processor chips are large-scale, and there are many duplicated cores. The configurations are same for most cases during testing. The test time will reduce significantly if the IJTAG network can be broadcast controlled.
- However, the TDR can not be broadcast controlled for IJTAG network, this means that the same data needs to be shifted multiple times and more shift cycles to every TDR even if the configuration of each TDR is the same. This disadvantage seriously affected the efficiency of configuration.



Main idea: A broadcastable JTAG network

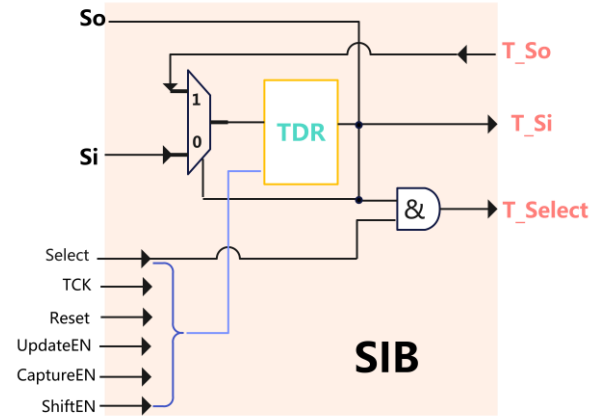
- Considering the demand to improve configuration efficiency, we propose a broadcastable IJTAG circuit network.
- The modified structure of IJTAG is displayed in the right figure. There are two new broadcast signals : BroadCast_TDI and BroadCast_Select.
- The BroadCast_TDI and BroadCast_Select signals controll every SIB broadcastlly same with other configuration signals such as CaptureEN.
- The data of BroadCast_TDI is same with TDI, it acts as data input when the IJTAG is in broadcast mode as its name indicates.
- The BroadCast_Select signal is controlled by a dedicate instruction. The IJTAG network will switch to broadcast mode if the BroadCast_Select signal asserts. In the broadcast mode, TDR can be configurated parallelly.



Main idea: The modified structure of SIB

- The schematic diagram of the SIB is demonstrated in Fig1. The SIB is a 1bit-TDR in actually. When ShiftEN is active, the data shifts from si, through the register, to so, in this condition , the SIB is closed and the data from si can not shift to the bottom-level TDR or SIB.
- When ShiftEN is active, the data from si shift into shift register, then UpdateEN is active, the data will transfer into update register, then Select signal is asserted, the data can continue shift into the bottom-level TDR or SIB and so can receive the data from the bottom-level TDR or SIB.
- Fig 2 is the schematic diagram of BroadCast_SIB. An extra bit TDR is inserted in SIB (this bit is named as BroadCast_bit), and BroadCast_bit is used to configurated SIB in broadcast mode or normal mode (non-broadcast mode).
- In normal mode, IJTAG works samely with original IJTAG network. The only difference is the TDR length of SIB increases to 2 bit.
- These SIBs with BroadCast_bit configured to 1 work in broadcast mode; Other SIBs and its bottom-level TDR hold original values and do not change.

Fig 1 the schematic diagram of SIB



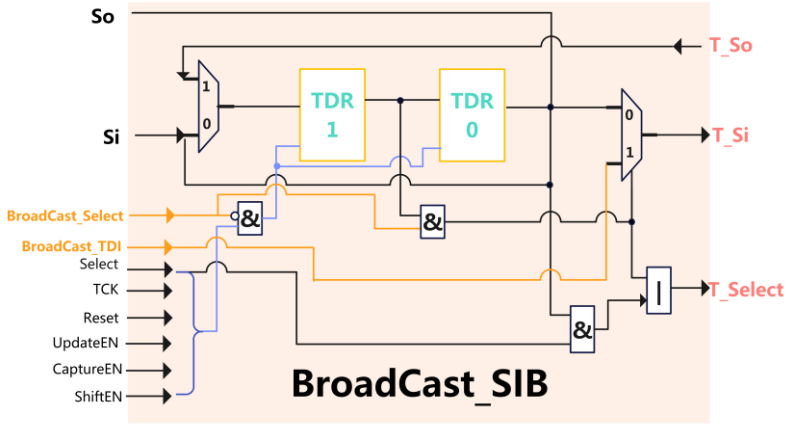


Fig 2 the schematic diagram of BroadCast_SIB

Usage & Benefits

- The broadcast IJTAG network is a very flexible feature, the working mode of each SIBs or the entire IJTAG network is completely determined by the users.
- Here is an example of configurating IJTAG to broadcast mode :
  - Firstly，we should determine which SIBs needs to work in broadcast mode. Then, two bit data 0, 1 are shifted into SIBs serially. It should be noted that the BroadCast_bit should be 1 for these SIBs, and other SIBs are 0.
  - Secondly, the broadcast control signal BroadCast_Select is asserted. These SIBs with broadcast configuration bit set to 1 are working in broadcast mode.
  - Finally, the configuration data are shift into broadcast SIBs and bottom-level TDR (or SIBs) through BroadCast_TDI signal.

- Here is the benefit for a design. The total number of blocks are X, Y blocks are duplicated and Z blocks are unique. The length of TDR for every SIB is 150. These Y identical blocks are grouped together, when configuring the group：
  - In normal mode (non-broadcast mode), the approximate total cycles for configurating all TDR are : Y + 150 x Y = 151 Y
  - If in broadcast mode, the total cycles are : Y x 2 +150 = 150 + 2 Y
  - The total cycles for configurating are significantly reduced in broadcast mode by contrast.
  - The more duplicated blocks, the longer TDR length of SIBs , and the advantage is greater in broadcast mode.

Summary

In this paper, we propose a broadcastable IJTAG network.

Two new broadcast signals BroadCast_TDI and BroadCast_Select are used to control SIBs. The BroadCast_TDI signal connects with TDI, it acts as data input when the IJTAG is in broadcast mode. The BroadCast_Select signal is controlled by a dedicate instruction. The IJTAG network will switch to broadcast mode if the BroadCast_Select signal asserted. In the broadcast mode, TDR can be configurated broadcastly.

The configuration cycles of TDR reduced a lot using broadcast IJTAG network and the efficiency of configuration is improved significantly.

Speakers introduction

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Feilong Pan

Sanechips Technology Co.,Ltd.
DFT Engineer

Minqiang Peng

Sanechips Technology Co.,Ltd.
DFT Engineer

Lei Yang

Sanechips Technology Co.,Ltd.
DFT Engineer

Pawini Mahajan

Synopsys Inc.
Sr. Staff Product Manager

AI

Security

Systems

EDA

Design

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