

SEMI-AUTOMATIC IN PLACE OPTIMIZATION

Customer Overview

The customer in this case is a diversified manufacturer and marketer of advanced electronic and electrical products, spanning information & communications equipment and systems, electronic components and materials, and household appliances. Headquartered in Japan, the customer has a truly global presence with multi-billion US dollar annual revenues.

Objectives

Being a large system design company, the customer has a fairly strong in-house EDA team. The mandate of the in-house EDA team is to provide niche features unavailable in the standard off-the-shelf tools from EDA vendors. These niche features provide the customer the competitive edge by enabling the best use of its key strengths and technologies.

To that effect, our customer had built a complete framework of tool suite over the years. The overall philosophy was to make use of the off-the-shelf tools for low complexity designs and use the in-house back-end tools for high performance designs. As part of this continued efforts, the client wanted us to provide solutions in two niche areas of the backend design process:

Wide Width Special Purpose Router (WWR):

The physical design methodology employed by the client involved using a combination of hand-crafted custom designed blocks along with cell-based design blocks. The client required a special purpose router for this design methodology wherein a semi-automatic routing of some key signals could be possible. These key signals had several routing constraints to be simultaneously managed such as variable wire width, net-to-net spacing, wide routing requirements (up to 100 times the width of normal signals) and special via requirements.

The commercially available area routers suffered from several limitations and could not handle all the design rules being imposed. For example, the grid based routers typically perform very poorly in the case of very wide width nets. Hence, there was a need to undertake a completely new routing approach to tackle issues such as wide width routing.

Semi-automatic In-Place Optimization (SIPO):

In-Place Optimization (IPO) is a process where some local modifications are done to the placement of the

cells after the initial physical layout is done. This involves some local transformations of the netlist and placement of cells to meet the timing constraints without the necessity of going through an entire new iteration of synthesis, floor-planning and layout. This is usually done through automatic tools by steps such as gate-sizing, buffer sizing and buffer insertion.

The client's design methodology dictated a manual control over this optimization process so that the designer who knows best about his/her design module could interactively guide the optimization. Needless to say, good optimization of the critical modules of the design is central to the performance of the entire design.

Approach

Since the requirements were clearly specified, a Turnkey Project based model of engagement was adopted wherein we promised to deliver within a specified time and cost.

Wide Width Special Purpose Router (WWR):

An area router with completely new approach was developed to address the specific requirements of the client. The approach was flexible enough to be able to introduce new constraints and drawing rules in the consideration set along with the technological advances. For example, antenna rules were not considered as part of the initial design specifications, but were added later to the features of the router.

Semi-automatic In-Place Optimization (SIPO):

The problem definition of SIPO required that us to build a suite of tools by which the designer could manually perform the In-Place Optimization for meeting the most critical timing constraints in the design. The emphasis was thus on overall ease of use and increased efficiency of manual optimization process.

The manual IPO can be done at the layout level. However, at this level, the layout designer does not see the "logic" of the design in a natural way. Analyzing the order of the cells that are automatically placed by the placement tool and the interconnections as decided by the automatic router will not help the layout designer to effectively carry out the IPO. Thus, a more effective approach was to first bring the design from the layout to the logic level.

In this regard, the following sequence of steps was adopted:

- The layout designer selects a portion of the layout having problems of meeting the critical timing constraints. This is done by pointing to an area in the layout of the design.
- The netlist corresponding to the selected area is converted into an equivalent EDIF 200 netlist by our tool.
- The EDIF 200 netlist is read into our Netlist-to-Schematic (N2S) tool and a corresponding EDIF schematic is generated.
- The EDIF 200 schematic is then displayed using an EDIF 200 schematic editor, BDE (Block Diagram Editor)

Using the above process, the layout designer sees the "logic" of the module under consideration in a natural way. The cells are represented using logical symbols and conveniently arranged to have the signal flow from left to right and control flow from top to bottom in the corresponding schematic page.

The layout designer can make the IPO optimizations on the schematic. All the requested optimizations at the schematic level get validated on-the-fly by the layout tool by having a tool-talk level communication between the layout tool and the schematic editor. If the requested optimization is not valid, the layout tool invalidates the corresponding step and the

schematic editor informs the same to the layout designer. Using this scheme, it is guaranteed that the layout designer only takes valid optimization steps.

This project involved re-use of a number of EDA IP blocks which were developed as part of other projects. The key EDA IP blocks that were re-used in this project were: EDIF parser, Netlist-to-Schematic (N2S) tool, and EDIF schematic editor.

Since both the above projects were niche tools as part of a design flow, the delivery team also developed the necessary interfacing tools to seamlessly integrate into the entire layout design framework of the client. This was achieved by using a well defined set of APIs made available by the customer using which it was possible to query as well as modify the client's internal database.

Result

Both the projects were completed successfully and are in use within the client's in-house proprietary layout design framework. The niche tools have increased the efficiency of the layout design process while still maintaining the overall methodology that the designers are comfortable working with.

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