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Flexible System-Level Characterization of Photonic Integrated Circuits in OptiSystem

Ahmad Atieh, Cem Bonfil, Benoit Vanus, Mike Raytchev
Optiwave Systems Inc.
Ottawa, Ontario, K2E 8A7 Canada
ahmad.atieh@optiwave.com

Abstract: Photonic integrated circuits (PICs) are the key technology for reducing the footprint, energy consumption and lower costs of optoelectronic modules. Characterizing these PICs is necessary not only at the chip level but also at the system level. OptiSystem software plays a key role enabling designers to evaluate their PIC designs. Integrating IPKISS software with OptiSystem supports a full optical communication system characterization of PICs. An automated characterization of a cross-connect switch and a ring resonator demultiplexer PICs conducted in OptiSystem.

Photonic Integrated circuits designed using Luceda IPKISS software, for an example, integrated in OptiSystem software and evaluated in a system designed to interrogate their capabilities and define the PICs specifications. The PIC designers need to evaluate their integrated circuit designs before and after performing mask layout. OptiSystem software incorporate many components that uses either idealized or measured models. These components include Mach-Zehnder interferometer (MZI), Mach-Zehnder modulator (MZM), splitter, combiner, S-parameter, waveguide, phase shifter. The available models in these components allow the designers to test their integrated circuit designs with a test bench before performing a mask layout of the PIC. Once the design is complete, the connection between OptiSystem and Luceda IPKISS allows the user to replace this circuit with a design extracted from a mask layout enabling full system level testing of the PIC. This process can be used to conducted before the manufacturing of the PIC saving cost and improving productivity.

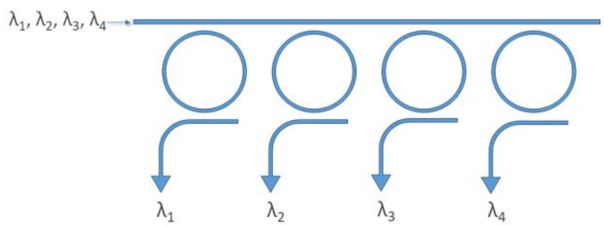

Fig 1. Four channels ring-resonator DEMUX schematic diagram.

In this paper, a flexible and automated characterization of a 4x4 cross-connect switch and a 4-channel ring resonator demultiplexer are evaluated in OptiSystem. Figure 1 shows the schematic diagram of the 4-channel ring resonator DEMUX. A python file for the PIC mask layout is created in OptiSystem to extract the netlist and create the ports of the PIC in the system layout. The signal type of each port of the PIC component is also identified in the python file to allow correct connection with other components in OptiSystem as shown in Figure 2. The DEMUX performance can be analyzed in OptiSystem and its specification can be verified.

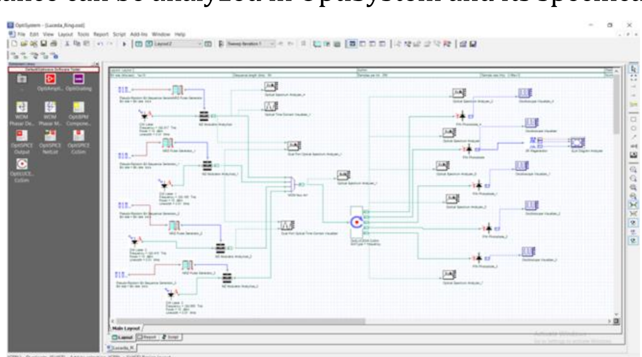

Fig 2. OptiSystem schematic layout for characterizing the 4-channel DEMUX PIC circuit.

The second PIC circuit discussed in this article is a 4x4 cross-connect switch. The schematic diagram of the switch is illustrated in Figure 3. The switch schematic shows six heaters that are used to control the switching path for the applied signals at each input port. An applied voltage of either 3.416V that represents a high voltage or a 2.416V that represents a low voltage are applied to the different heaters following a truth table to control the switching paths. When the sequence 010101 is applied, the input port 1 is connected to the output port 4, while the input port 4 is connected to the output port 1. The other two input ports 2 and 3 are not cross-connect and kept connected to the output port 2 and 3, respectively. The PIC designer creates the truth table and supplies it to the system designer to check the switch performance.

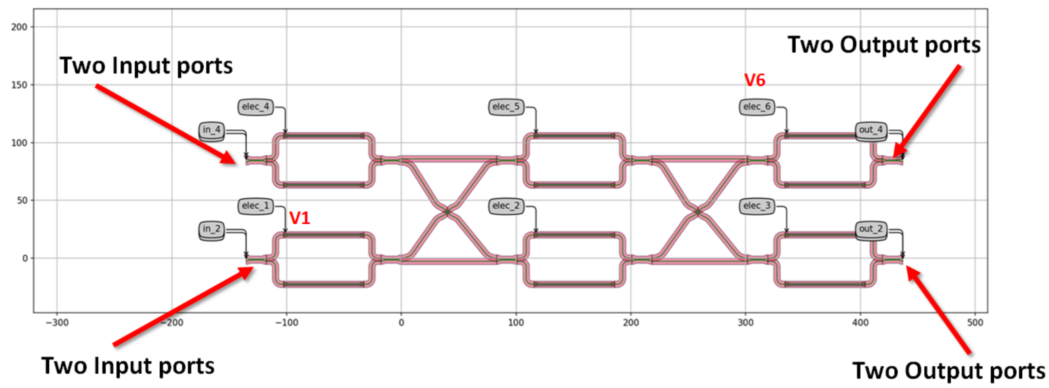

Fig 3. 4x4 cross-connect switch layout.

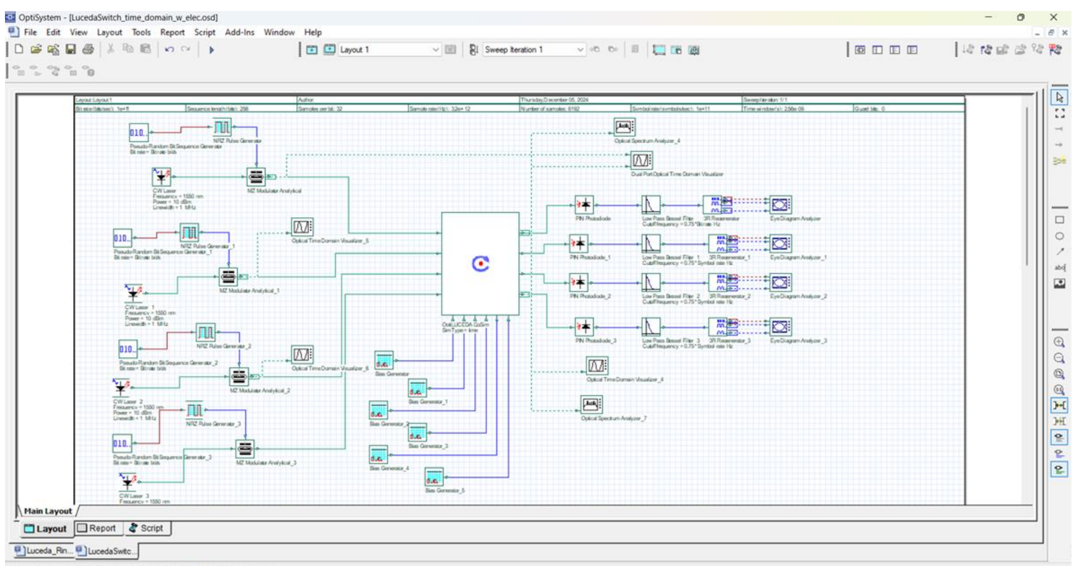

Fig.3 4x4 cross-connect switch layout.