The figure above shows the block diagram of the generic add-drop ring configuration. Complex amplitudes of waves are labeled in the figure. Here only unidirectional propagation is considered.

If we assume the two couplers are lossless, the S matrices of coupler 1 and 2 labeled as green blocks may be written as follows given time reversibility:

 

This formalism gives:

 (1)

 (2)

Denote the amplitude transmission coefficient and length of ring section 1 as 1 and L1, respectively, and the waveguide effective index as neff, we have:

 (3)

where k0 is the free space wave vector. Similarly, we have:

 (4)

The linear equations (1) to (4) may be written in a matrix form as:



where

 and 

The output wave amplitudes st and sd can then be solved from the set of linear equations.