

1. Consider the recursive construction of an $N \times N$ rearrangeably non-blocking Clos network using only $p \times p$ crossbars only.

(a) Show that the number of crosspoints n_{cp} is given by

$$n_{cp} = Np(2 \log_p N - 1)$$

as a function N and p . Hint: you should first find out how many rounds of factorisation is required to deconstruct an $N \times N$ Clos network.

- (b) For large N , show that $p = 3$ minimises the crosspoint count.
2. Compute the crosspoint complexity, logical depth (the number of logical gates in a path), and fan-out (the number of logical gates driven by the input or by any gate in the network) for the following networks.
 - (a) The full $N \times N$ crosspoint switch.
 - (b) The three stage rearrangeable Clos network constructed using $\sqrt{N} \times \sqrt{N}$ switches.
 - (c) The Benes network.

3. A 2×2 crossbar has 4 crosspoints, giving a total of $2^4 = 16$ crosspoint settings. Which of these constitute legitimate point-to-point and multicast connection patterns?

4. Show that the Bayan, baseline, and omega networks (slide L5-46) have the self-routing property.

5. For the 8×8 Benes network, use the looping algorithm to find the paths for the following permutation:

input	1	2	3	4	5	6	7	8
output	3	6	2	1	8	4	5	7