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## **FULLY CONNECTED GENERALIZED MULTI-STAGE NETWORKS**

**Venkat Konda**

### **5 CROSS REFERENCE TO RELATED APPLICATIONS**

This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0038US entitled "FULLY CONNECTED GENERALIZED BUTTERFLY FAT TREE NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

10 This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0039US entitled "FULLY CONNECTED GENERALIZED REARRANGEABLY NONBLOCKING MULTI-LINK MULTI-STAGE NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

15 This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0040US entitled "FULLY CONNECTED GENERALIZED MULTI-LINK BUTTERFLY FAT TREE NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

20 This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0041US entitled "FULLY CONNECTED GENERALIZED FOLDED MULTI-STAGE NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

25 This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0042US entitled "FULLY CONNECTED GENERALIZED STRICTLY NONBLOCKING MULTI-LINK MULTI-STAGE NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

This application is related to and incorporates by reference in its entirety the U.S. Provisional Patent Application Docket No. M-0045US entitled "VLSI LAYOUTS OF FULLY CONNECTED GENERALIZED NETWORKS" by Venkat Konda assigned to the same assignee as the current application, filed concurrently.

## 5 BRIEF DESCRIPTION OF DRAWINGS

FIG. 1A is a diagram 100A of an exemplary symmetrical multi-stage network  $V(N, d, s)$  having inverse Benes connection topology of five stages with  $N = 8$ ,  $d = 2$  and  $s=2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

FIG. 1B is a diagram 100B of a general symmetrical multi-stage network  $V(N, d, 2)$  with  $(2 \times \log_d N) - 1$  stages strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections in accordance with the invention.

FIG. 1C is a diagram 100C of an exemplary asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  having inverse Benes connection topology of five stages with  $N_1 = 8$ ,  $N_2 = p * N_1 = 24$  where  $p = 3$ , and  $d = 2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

FIG. 1D is a diagram 100D of a general asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  with  $N_2 = p * N_1$  and with  $(2 \times \log_d N) - 1$  stages strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections in accordance with the invention.

FIG. 1E is a diagram 100E of an exemplary asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  having inverse Benes connection topology of five stages with  $N_2 = 8$ ,  $N_1 = p * N_2 = 24$ , where  $p = 3$ , and  $d = 2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

FIG. 1F is a diagram 100F of a general asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  with  $N_1 = p^* N_2$  and with  $(2 \times \log_d N) - 1$  stages strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections in accordance with the invention.

5            FIG. 1A1 is a diagram 100A1 of an exemplary symmetrical multi-stage network  $V(N, d, 2)$  having Omega connection topology of five stages with  $N = 8$ ,  $d = 2$  and  $s=2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

10           FIG. 1C1 is a diagram 100C1 of an exemplary asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  having Omega connection topology of five stages with  $N_1 = 8$ ,  $N_2 = p^* N_1 = 24$  where  $p = 3$ , and  $d = 2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

15           FIG. 1E1 is a diagram 100E1 of an exemplary asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  having Omega connection topology of five stages with  $N_2 = 8$ ,  $N_1 = p^* N_2 = 24$ , where  $p = 3$ , and  $d = 2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

20           FIG. 1A2 is a diagram 100A2 of an exemplary symmetrical multi-stage network  $V(N, d, 2)$  having nearest neighbor connection topology of five stages with  $N = 8$ ,  $d = 2$  and  $s=2$  with exemplary multicast connections, strictly nonblocking network for unicast connections and rearrangeably nonblocking network for arbitrary fan-out multicast connections, in accordance with the invention.

25           FIG. 1C2 is a diagram 100C2 of an exemplary asymmetrical multi-stage network  $V(N_1, N_2, d, 2)$  having nearest neighbor connection topology of five stages with  $N_1 = 8$ ,  $N_2 = p^* N_1 = 24$  where  $p = 3$ , and  $d = 2$  with exemplary multicast connections, strictly

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