Slim Fly: A Cost Effective Low-Diameter Network Topology

Sep 2023

Slim Fly Advantages

- Nearly full optimal global bandwidth (based on Moore Bound: a maximum number of routers given network diameter and router radix)
- More resilient
- Lower the network diameter
- Cost and power benefit (optical cable, and high-radix routers)[1]

[1] Maciej Besta and Torsten Hoefler. "Slim fly: A cost effective low-diameter network topology". In: *SC'14: proceedings of the international conference for high performance computing, networking, storage and analysis*. IEEE. 2014, pp. 348–359.

General structure

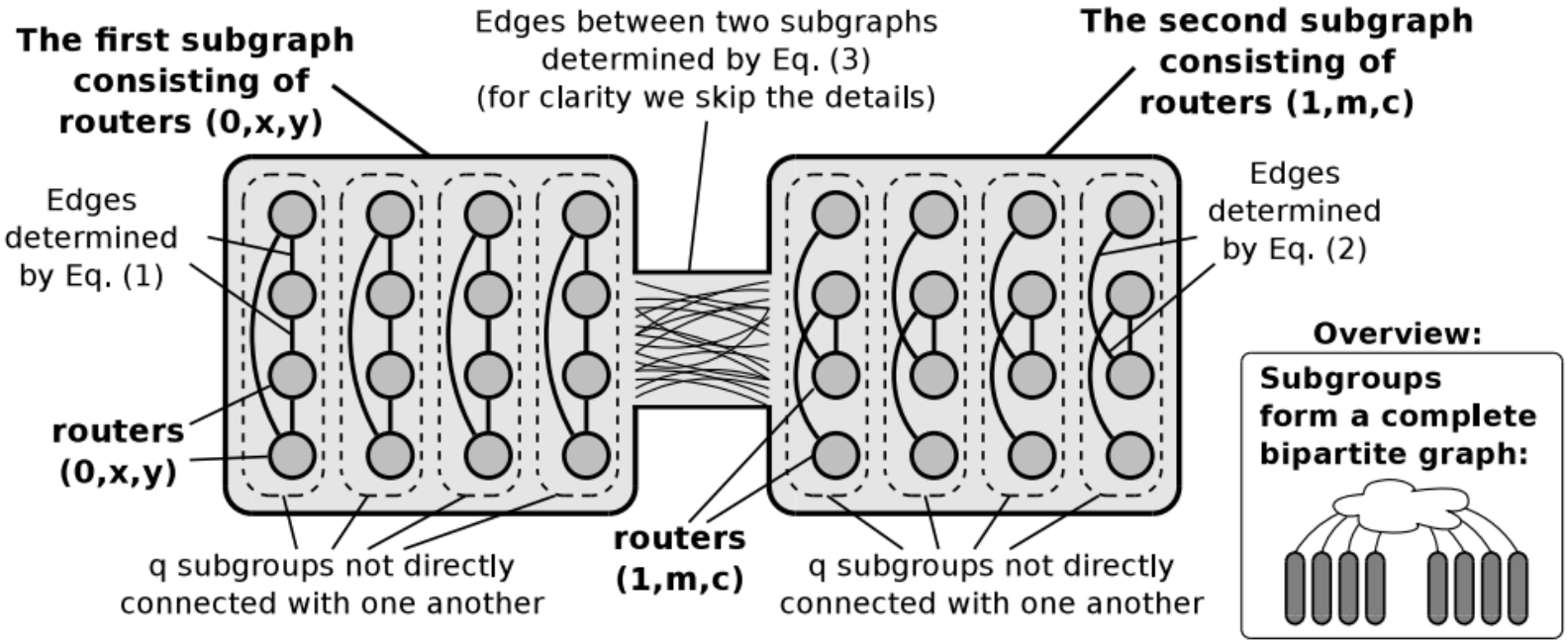

Fig. 2: General structure of the MMS graph (§ II-B1).

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[2] Maciej Besta and Torsten Hoefler. "Slim fly: A cost effective low-diameter network topology". In: *SC'14: proceedings of the international conference for high performance computing, networking, storage and analysis*. IEEE. 2014, pp. 348–359.

SF MMS construction

Given q=5, construct the MMS:

- Determine the prime power $q = 4\omega + \delta$; # channels $k' = \frac{3q-\delta}{2}$; # routers $N_r = 2q^2$
- Determine the ξ (number of that generates F_q. In this case, $F_5 = \{0, 1, 2, 3, 4\}$)
  In this example, $\xi = 2$ ($1 = \xi^4 \ mod\ 5$)
- Construct generators: $X = \{1, \xi^2, ..., \xi^{q-3}\}$ and $X' = \{\xi, \xi^3, ..., \xi^{q-2}\}$
  Ex: Modulo q: $X = \{1, 4\}$ and $X' = \{2, 3\}$[3]

[3] Maciej Besta and Torsten Hoefler. "Slim fly: A cost effective low-diameter network topology". In: *SC'14: proceedings of the international conference for high performance computing, networking, storage and analysis*. IEEE. 2014, pp. 348–359.

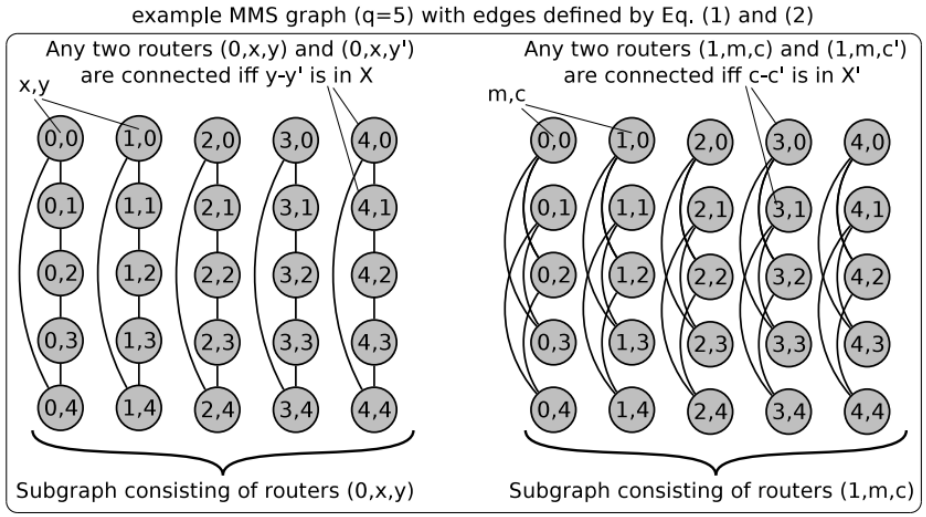
SF MMS construction

Routers connection in a subgraph

$(0, x, y)$ to $(0, x, y')$ $\iff$ $y - y' \in X$

$(1, m, c)$ to $(1, m, c')$ $\iff$ $c - c' \in X'$

Ex: (x,y): (1,0) connect to (1,4) b/c 4 - 0 = 4 in X = $\{1, 4\}$



(a) Connections between routers in each subgraph (§ II-B1, Eq. (1)-(2)). Note that respective groups have identical connection patterns. [4]

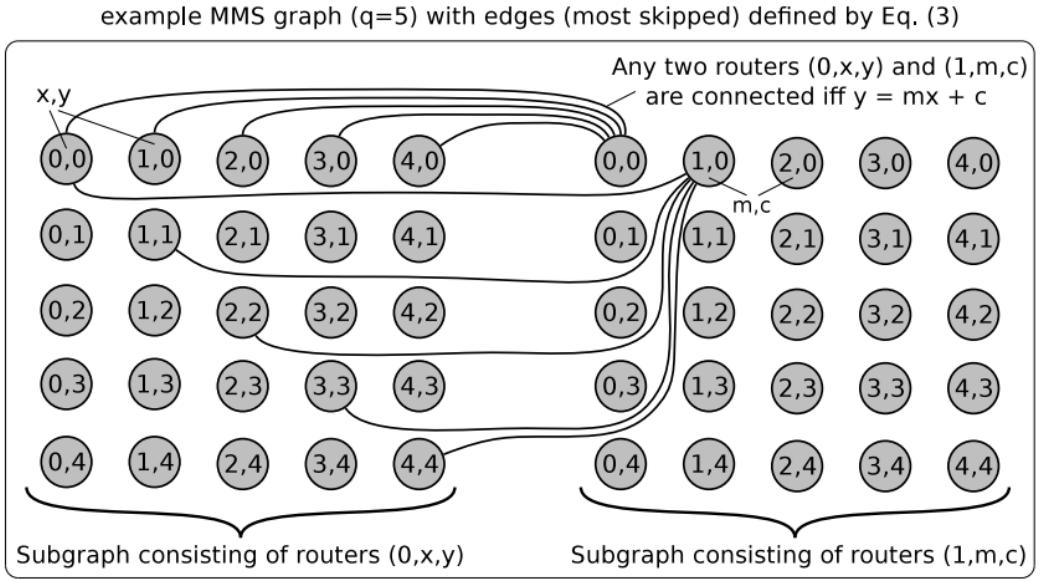
[4] Maciej Besta and Torsten Hoefler. "Slim fly: A cost effective low-diameter network topology". In: *SC'14: proceedings of the international conference for high performance computing, networking, storage and analysis*. IEEE. 2014, pp. 348–359.

SF MMS construction

Routers connection between subgraphs

$(0, x, y)$ to $(1, m, c) \iff y = mx + c$

Ex: (x,y)(2,2) to (m,c)(1,0) b/c 2 = 1 * 2 + 0 = 2



(b) Connections between two subgraphs (§ II-B1, Eq. (3)). For clarity we present only the edges originating at $(1, 0, 0)$ and $(1, 1, 0)$. [5]

[5] Maciej Besta and Torsten Hoefler. "Slim fly: A cost effective low-diameter network topology". In: *SC'14: proceedings of the international conference for high performance computing, networking, storage and analysis*. IEEE. 2014, pp. 348–359.

References

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