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Deterministic routing with bounded buffers: turning offline into online protocols. (English)
Zbl 1107.68529

Summary: In this paper we present a deterministic protocol for routing arbitrary permutations in arbitrary networks. The protocol is analyzed in terms of the size of the network and the routing number of the network. Given a network $H$ of $n$ nodes, the routing number of $H$ is defined as the maximum over all permutations $\pi$ on $\{1, \ldots, n\}$ of the minimal number of steps to route $\pi$ offline in $H$. We show that for any network $H$ of size $n$ with routing number $R$ our protocol needs $O(\log R \cdot n \cdot R)$ time to route any permutation in $H$ using only constant size edge buffers. This significantly improves all previously known results on deterministic routing. In particular, our result yields optimal deterministic routing protocols for arbitrary networks with diameter $\Omega(n^\epsilon)$ or bisection width $O(n^{1-\epsilon})$, $\epsilon > 0$ constant. Furthermore we can extend our result to deterministic compact routing. This yields, e.g., a deterministic routing protocol with runtime $O(R \log n)$ for arbitrary bounded degree networks if only $O(\log n)$ bits are available at each node for storing routing information.

Our protocol is a combination of a generalized “routing via simulation” technique with an new deterministic protocol for routing $h$-relations in an extended version of a multibutterfly network. This protocol improves upon all previous routing protocols known for variants of the multibutterfly network. The “routing via simulation” technique used here extends a method previously introduced by the authors for designing compact routing protocols.

MSC:

- 68W10 Parallel algorithms in computer science
- 68M10 Network design and communication in computer systems
- 68M20 Performance evaluation, queueing, and scheduling in the context of computer systems
- 68W15 Distributed algorithms

Keywords: routing; buffers; multibutterfly network

Full Text: DOI