IEICE Journal (ED) Special Issue of CANDAR

• Your efficient graph-generation method should be opened in a journal

• Submission deadline: Jan. 7, 2020. (No Extension)

https://review.ieice.org/regist/regist_baseinfo_e.aspx

Call for Papers

--- Special Section on Parallel, Distributed, and Reconfigurable Computing, and Networking ---

The IEICE Transactions on Information and Systems announces that it will publish a special section entitled "Special Section on Parallel, Distributed, and Reconfigurable Computing, and Networking" in December 2020.

The objective of this special section is to publish and overview recent progress in the interdisciplinary area of Parallel, Distributed, and Reconfigurable Computing, and Networking. This special section will include papers based on the presentation at the International Symposium on Highly-Efficient Accelerators and Reconfigurable Technologies (HEART’19) and the International Symposium on Computing and Networking (CANDAR’19) in addition to papers applied for this call for papers. All submitted papers are subjected to the same review process as those papers accepted for publication in the regular issues.
Why don't you use a better graph as network topology of supercomputers?

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2019/11/26
From Graph Golf to Real NW Topology on Supercomputers

On-chip Network Topology
→ Grid Graph

Off-chip Network Topology
→ general graph
Index

• Many-core is a game changer for network-topology design

• Recommendations of GraphGolf network topologies from different aspects
Supercomputers @ Top500

- x1,000 times improvement over 10 years
- Recently, “Many Cores”

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Performance Development

1,000 processors
5,000 processors
10M Cores

1 bit = 0/1
Kilo=10^3
Mega=10^6
Giga=10^9
Tera=10^12
Peta=10^15
Exa = 10^18
Zetta=10^21
```

http://www.top500.org
“Many-Core” is a game changer (1)
→ General Graph Category

- Low Latency: 1 $\mu$s latency across system
  - Minimize latency for small message (< 3KiB) (fine-grained parallelism)
  [IAA Interconnection network workshop, final report 2008]

→ GraphGolf Competition
- Low diameter of network topologies
- General Graph Category

(a) Traditional supercomputer’s NW Message delay becomes large
(b) GraphGolf’s-like NW Shortcuts efficiently work
“Many-Core” is a game changer (2)

Grid Graph Category

- Scalability: greater than 100,000 endpoints
  - 1 endpoint includes 100~ cores
  [IAA Interconnection network workshop, final report 2008]

GraphGolf

- Network topology within an endpoint [on-chip network]
- Grid Graph Category
  - Short edge length

(a) Intel’s Nehalem Architecture

4 Cores

Multi-Core & Many-Core

Number of PEs (caches are not included)

- picoChip PC102
- ClearSpeed CSX700
- Intel 80-core
- TILERA TILE64
- Intel SCC
- ClearSpeed CSX600
- STI Cell BE
- Sun T1
- Sun T2
- Fujitsu SPARC64
- Intel Core, IBM Power7
- AMD Opteron

Index

• Many-core is a game changer for network-topology design

• Recommendations of GraphGolf network topologies from different aspects
Recommendation 1: **High Feasibility**

80% of top500 supercomputers can use GG NW Topology

- Ethernet + InfiniBand ≈ 80% in top500 supercomputers
- Support arbitrary network topology

http://www.top500.org
Recommend. 2: High Bandwidth

- GraphGolf topology = tightly coupled network topology
Recommend. 3: **Low cost of GG NW topologies**

- 7 hops for 970ns

- Low switch degree (radix) leads to the low network cost
  - **Graph Golf’s network topology is also advantage in terms of cost**

![Diagram showing network hops and costs](image)

(a) Cable cost model.  (b) Routers cost model  

M. Besta et al, SC14
Recommendation 3: **Killer Traffic Patterns**

- All-to-all access
  - GG NW topology is better
- Pure stencil access
  - Topology does not impact

![Graph showing performance comparison between 2D-Torus and Random topologies for CG, FT, and Graph500 workloads.](image)

F. Chaix et al., PDP16
Recommend. 4: High Fault Tolerance

- Unstructured NW topology is still unstructured NW topology w/ miscabling/link failure

Figure 6. Fault tolerance vs. degree ($N = 2^{12}$ vertices).

M. Koibuchi et al, ISCA2012
Conclusions

• Traditional NW topologies are no longer a best solution on many-core supercomputers
  → GraphGolf graphs

On-chip NW Topology
→ Grid Graph

Off-chip NW Topology
→ General Graph