# NEWS RELEASE

大学共同利用機関法人 情報・システム研究機構
国立情報学研究所
National Institute of Informatics

November 24, 2021

# Discovery of the indirect network with the smallest theoretical diameter

## in the Graph Golf, a competition to find graphs leading to the efficient design of supercomputers.

## -- Effective also in configurations where network switches are used for indirect connections between CPUs --

National Institute of Informatics (NII; Director General: Dr. KITSUREGAWA Masaru; Tokyo, Japan) held an award ceremony today, on November 24 for Graph Golf 2021(*1), a competition for finding network configurations for future supercomputers, at CANDAR2021(*2), an international symposium held online. The Graph Golf 2021 is a competition to find graphs by which the connections between CPUs that correspond to the network configurations used in supercomputers were shown, leading to the efficient design of networks between CPUs. This year's award winners include the team of NAKAO Masahiro (RIKEN Center for Computational Science), TSUKAMOTO Masao (Kansai University), HANADA Yoshiko (Kansai University) and

https://www.nii.ac.jp/en/news/release/2021/1124.html

# IEICE Journal (ED) Special Issue of CANDAR

- Your efficient graph-generation method should be opened in a journal
- Submission deadline: **Dec. 13, 2021.**
  (No Extension)

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

**Call for Papers**

--- Special Section on Forefront Computing ---

The IEICE Transactions on Information and Systems announces that it will publish a special section entitled "Special Section on Forefront Computing" in December 2022.

The objective of this special section is to publish and overview recent progress in the interdisciplinary area of computer architecture, reconfigurable systems, software for computer system, algorithms for parallel, distributed, and networking. This special section will include papers based on the presentation at the International Symposium on Computing and Networking (CANDAR'21) 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.

**1. Scope**

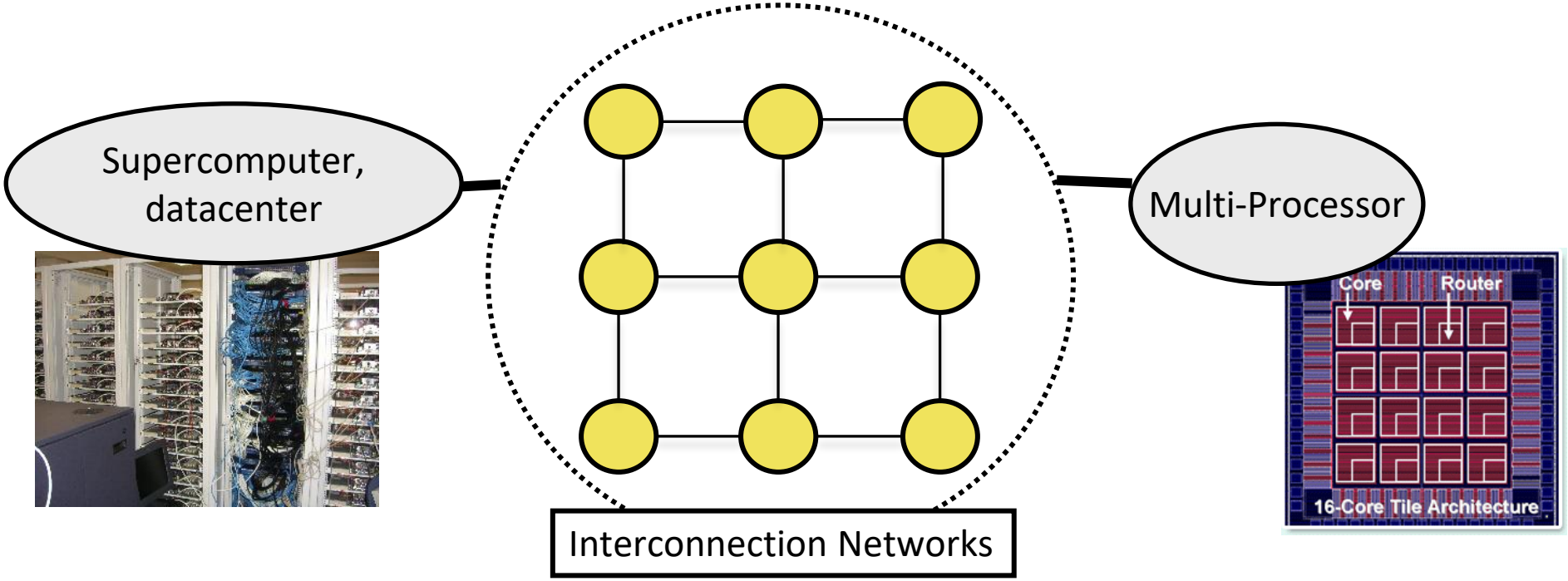
This special section aims at timely dissemination of research in these areas. Possible topics include, but are not limited to:

- Reconfigurable systems and architectures (parallel processor architectures, cluster/grid systems, network and storage architectures, network-on-chip, high performance interconnect, FPGA, PLD, dynamic reconfiguration, and virtual hardware)
- Technologies for reconfigurable systems (device and circuit, design and verification, high-level synthesis, energy-efficient, asynchronous, and reliable systems, and prototyping)
- Software for computer system and reconfigurable systems (operating systems, middleware, tools, virtualization, parallel programming


Organizer’s Talk

# Self Introduction: M. Koibuchi

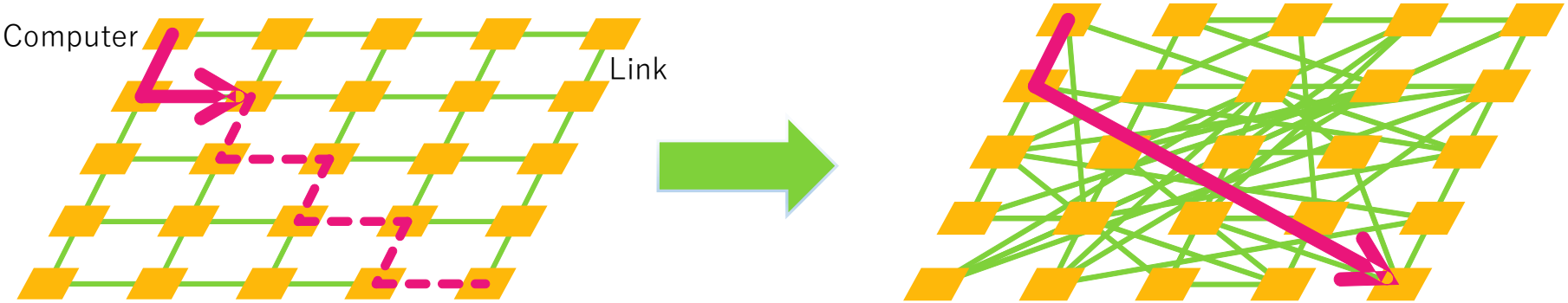
- Assoc. Prof. in National Inst. of Informatics, JP
- Interconnection networks and computer architecture
- 100 referred technical papers
  - 9 in IEEE Trans. on Par. and Dist. Systems, 5 in the IPDPS, 4 in the HPCA, and 4 in IEEE Trans on Computers



- **From Graph Golf to HPC Network**

# Guideline to Graph Golf Supercomputers

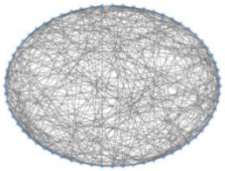
Graph Golf network effects multiple design layers, leading to unique low-latency supercomputers



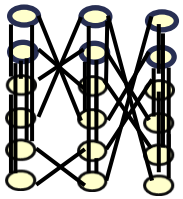

Existing Supercomputer

Supercomputer with Graph Golf Network Topology

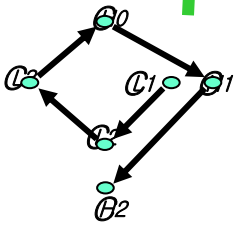
Change for GG network topology



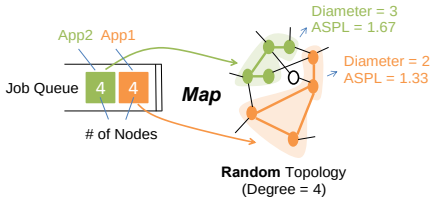
(a) Network Topoogy



(b) Floorplan (Cabling)




- Routing
- Collectives

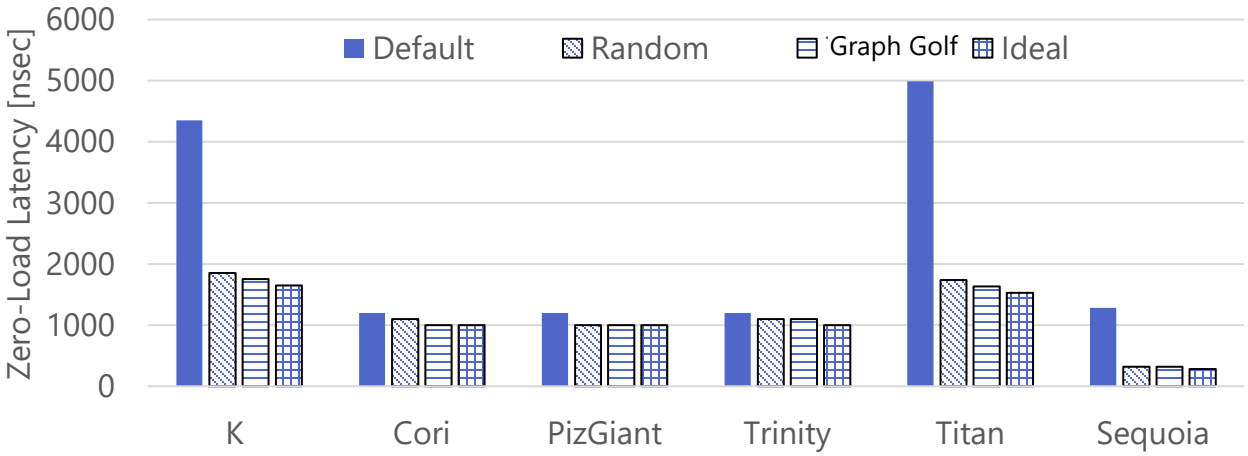



- Fault Tolerance
- Job Placement

# Impact of Graph Golf NW Topology

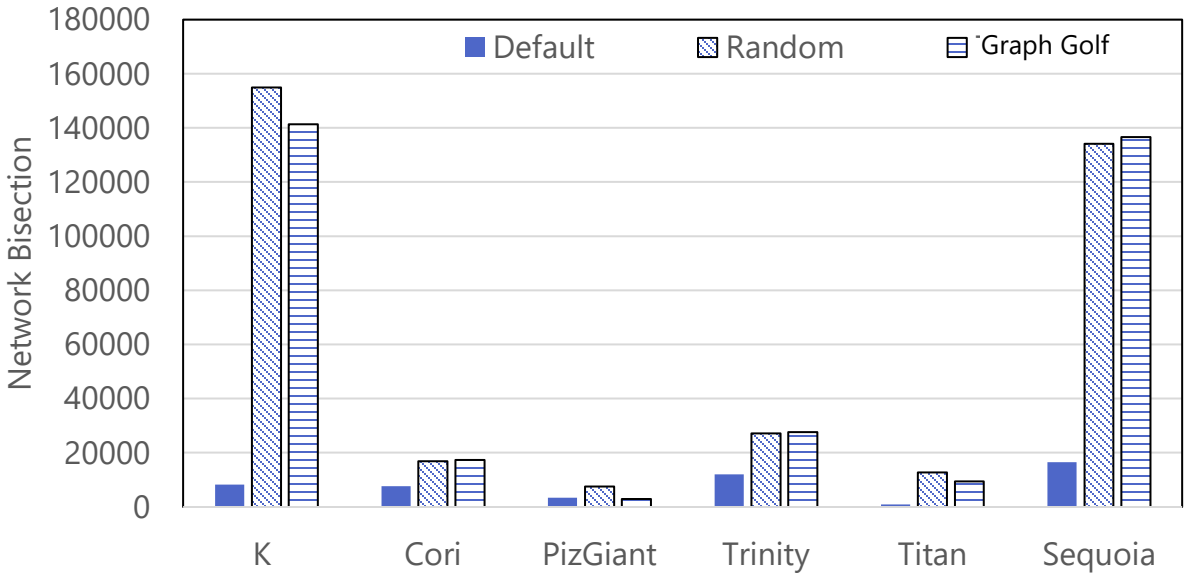


## Max. Zero-load Comm Latency(-75%)




| | Default |
|---|---|
| K | Torus |
| Cori | Dragonfly |
| PizDaint | Dragonfly |
| Tirinity | Dragonfly |
| Titan | Torus |
| Sequoia | Torus |

## Network Bisection (18x)



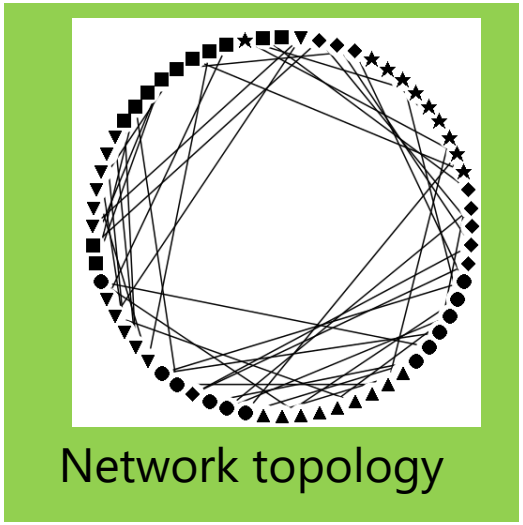
# (b) Floorplan



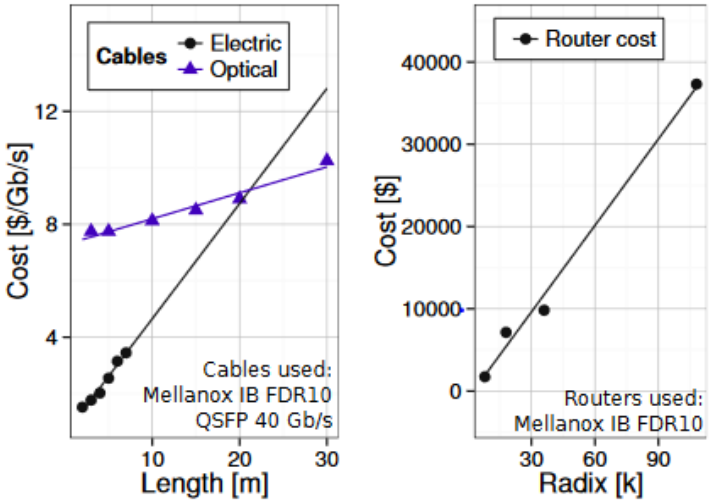
- We provide a tool for minimizing total cable length

Min. # of inter-rack cables

Min. cable length



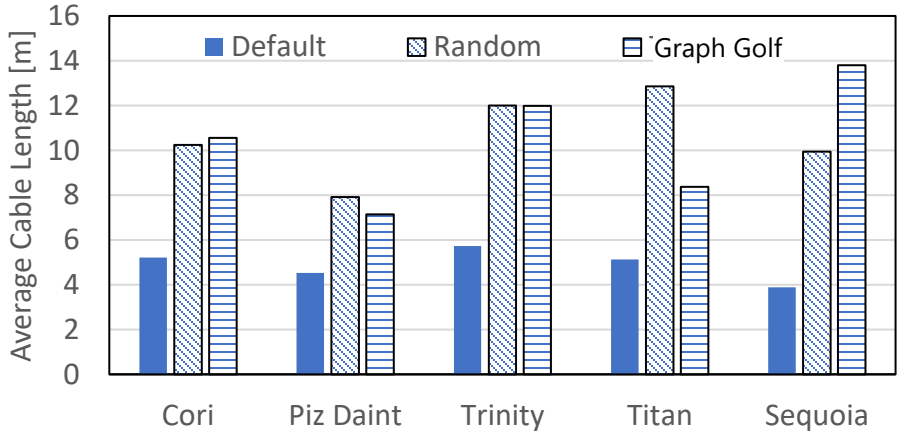

[I.Fujiwara, M.Koibuchi, H.Casanova, PDCAT 2012]




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

[M.Besta et al, SC14]

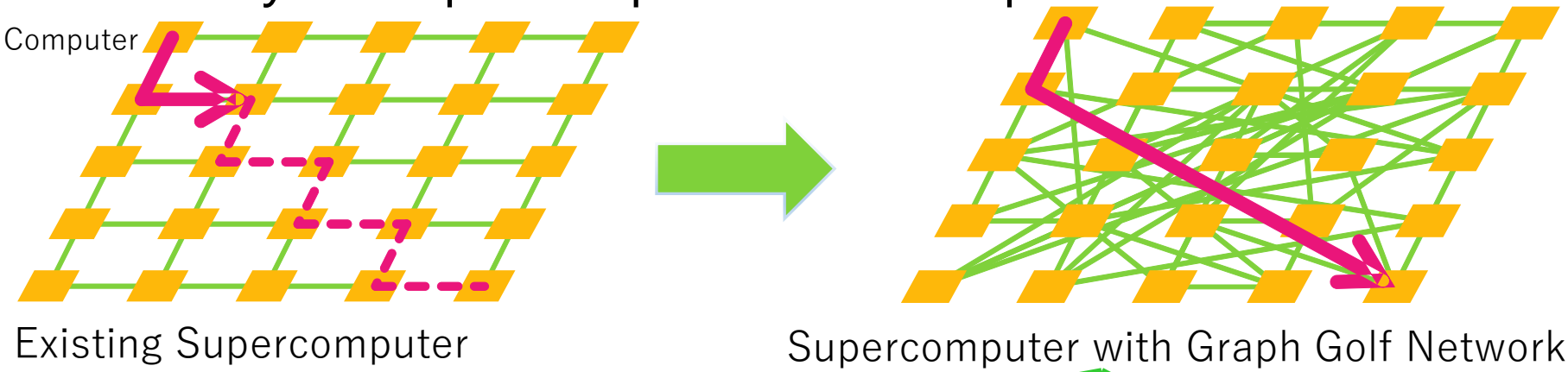
## Avg. cable length (x3.5)



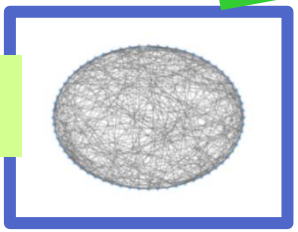
# Summary

Across Theoretical Research (Graph Golf) and Practical Development (Supercomputers)

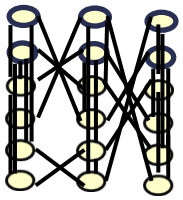
- **http://research.nii.ac.jp/graphgolf**
- Ready for supercomputers with Graph Golf networks



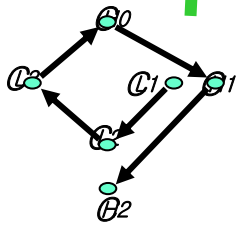

Change for GG network topology



Network Topology



Floorplan (Cabling)



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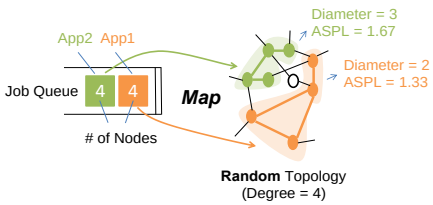
- Collectives




- Fault Tolerance
- Job Placement