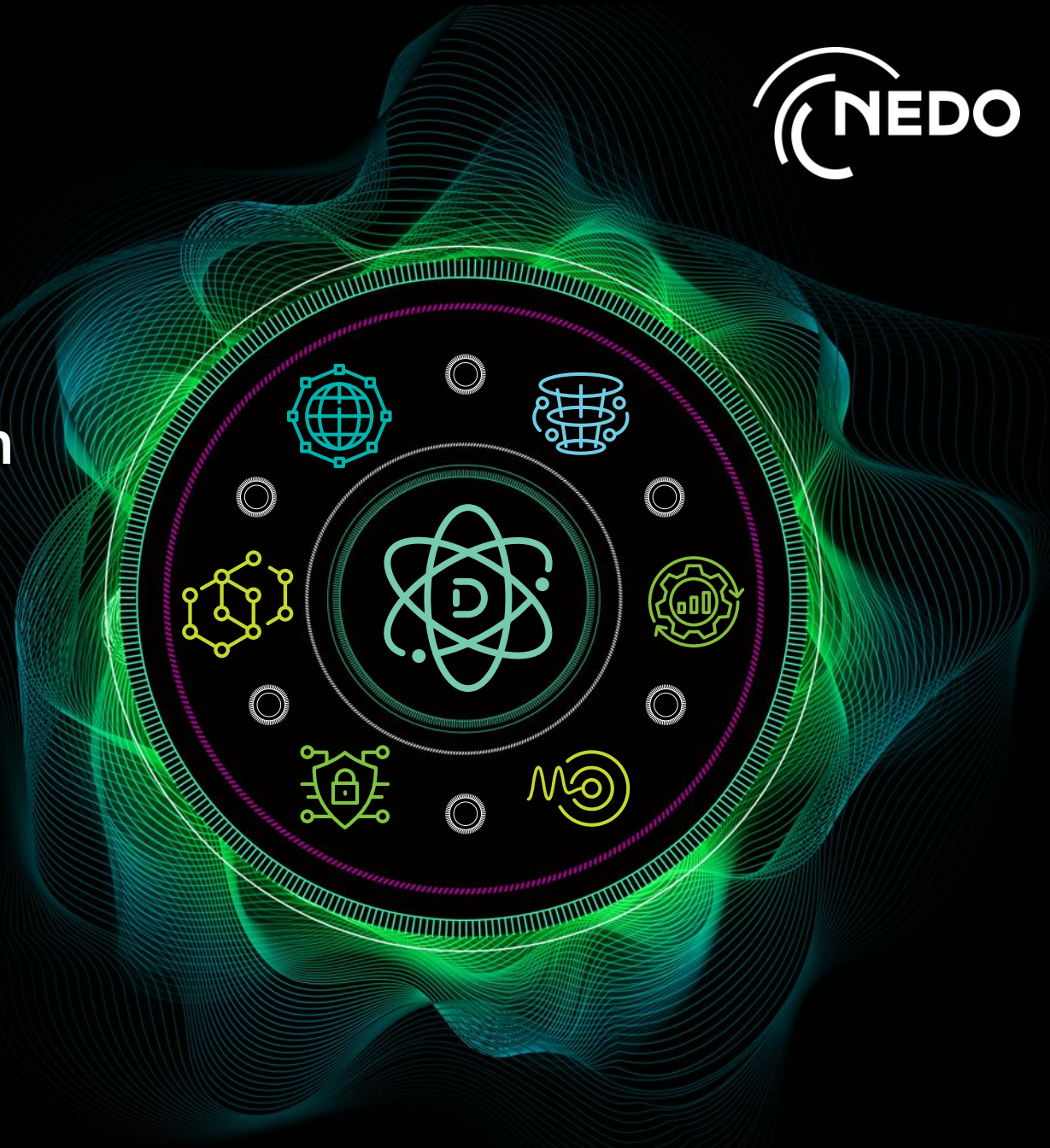
Quantum Computing Use Cases

Optimization of radio base station settings

SoftBank Corp.



New Energy and Industrial Technology Development Organization (NEDO)

SoftBank Corp.: Optimization of radio base station settings [2025/7]

Validation

Industry	Other
Process	Other
Method	combinatorial optimization
Category	Ising*

Background

- Carrier Aggregation (CA) is a technology that realizes high-speed and stable communications by simultaneously using radio waves of multiple frequency bands, and it is necessary to establish the association between base stations (hereinafter, “CA link ”) in advance.
- However, due to the increase in the number of base stations, the configuration of CA links has become dramatically more complex.
  - For example, there are 45 possible combinations of 2 stations from 10 stations, and each combination has the option of "set or not set CA link," resulting in a total of 35 trillion combinations (2 to the power of 45).
  - In addition, limitations such as the maximum number of CA links that can be configured per base station make it extremely difficult to find the optimal combination that maximizes CA coverage.

Issues and motivation to be solved

- Because of limitations such as the maximum number of CA links that can be configured per base station, it is extremely difficult to find the optimal combination that maximizes the CA's available area.
- a computer specialized in combinatorial optimization problems that finds an optimal solution by searching for a state that minimizes energy

Problem setting as a quantum computer

- The distribution of areas where carrier aggregation (a method of increasing communication speed by bundling multiple frequency bands) is available is expressed by a mathematical model based on radio wave conditions from multiple base stations, and the optimum setting is calculated in a short time using mathematical optimization.

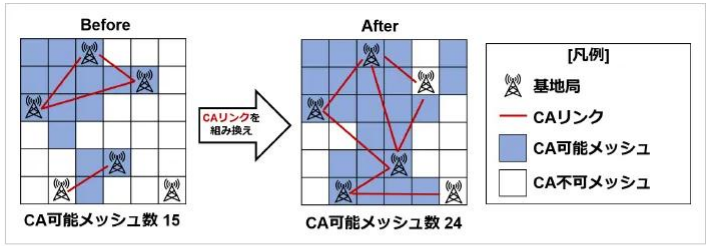


図1. CA可能メッシュ数を最大化するようにCAリンク構成を最適化

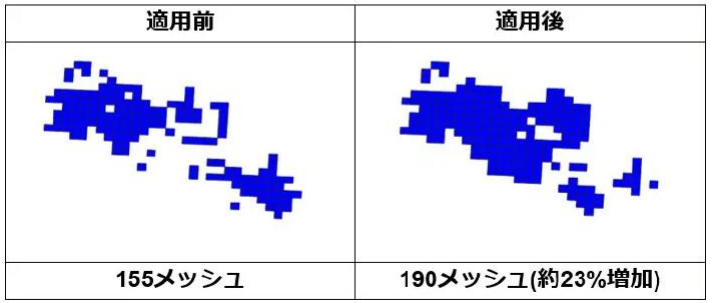


図2. 最適化前後のCA可能エリアの一例（青いメッシュ部分がCA使用可能エリア）

Optimization of base station and CA link combination

Expected business benefits

- As a result of testing in Tokyo area, downlink data communication speed using carrier aggregation improved by about 10% and data communication volume increased by up to 50%.
- Demonstration of significant improvement in communication quality with only existing equipment
- They are classified into classical type, quantum type, and quantum inspired type, and are expected to be applied in various fields such as logistics and finance.

Reference: SoftBank Corp. "Optimizing Wireless Base Station Settings to Improve Communication Performance Using Quantum Computing Technology" (https://www.softbank.jp/corp/news/press/sbkk/2025/20250729_01/)
*Ising: A computing approach, mainly associated with quantum annealers and simulators specialized for the Ising model, in which a problem is first formulated as an Ising model and then solved computationally. It is particularly well suited to problems that involve finding the optimal combination from a vast number of possibilities.

More use cases are available on our website. We invite you to explore them.
https://www.quantum-computing-use-cases.nedo.go.jp/english/

More Use Cases

New Energy and Industrial Technology Development Organization (NEDO)
AI and Robotics Department (e-mail: quantum_ai@ml.nedo.go.jp)

This collection of use cases was obtained as a result of the work commissioned by the New Energy and Industrial Technology Development Organization (NEDO) "Cyber-Physical Development Business of Quantum/Classical Hybrid Technology/Study of Use Case of Quantum Technology" and the “Post-5G Information and Communications System Infrastructure Reinforcement R & D Project (Quantum Industrialization)/Comprehensive Study for Promoting the Industrialization of Quantum Computers”.