

# Media Backgrounder Digital Annealer

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Fujitsu Laboratories' Digital Annealer, jointly developed with the University of Toronto, is designed to solve combinatorial optimization problems that have been difficult to address in the past. Using quantum-inspired computing technology and without setting complex parameters, Fujitsu Laboratories' Digital Annealer computational architecture addresses these challenges, and paves the way for much faster, more efficient materials design, drug discovery, investment portfolio optimization, supply chain optimization, and post-disaster recovery planning. It will also enable the development of new ICT services that support swift and optimal decision-making in such areas as social policy and business, which involve complex intertwined elements.

There is a widespread real-world demand for the ability to choose the optimal solution from a number of different feasible options, which are classified as combinatorial optimization problems – essentially finding the best combination from an enormous set of potential elements. Combinatorial optimization problems can be difficult to solve in reasonable time with conventional processors, as the number of combinations increase exponentially when the number of factors taken into consideration is increased. And in conventional Monte Carlo simulations using annealing methods, there is a tradeoff between the speed with which the method converges on a solution and the accuracy of the solution.

As a versatile hardware accelerator for solving combinatorial optimization problems, the Fujitsu Digital Annealer technology makes it possible to find a sufficiently precise solution without the need to set complicated parameters. It achieves this by incorporating circuits that automatically control parameters based on the results of observations of conditions within the Digital Annealer during its performance. This can reduce the preparation time involved before applying the Digital Annealer to a new kind of problem from about two weeks to less than a day, with problem-solving examples including the comparison of molecular similarities when searching for new materials or for investment portfolio optimization.

The technology involves 1024-bit scale, inter-bit full connectivity to deliver large scale performance and high flexibility, with 16-bit inter-bit connection precision for the ultimate accuracy. With Fujitsu Laboratories' Digital Annealer, users will be able to find an optimal solution with high probability without setting complex parameters in advance. A key benefit is its ability to address time-consuming tasks that could previously only be done manually, enabling users to start operations with actual data and to rapidly draw out the full performance potential of the Digital Annealer, potentially shortening preparation times by a factor of 10 to 100.

Fujitsu Laboratories plans to apply this new technology to products during the first half of 2018, contributing to the creation of new business by applying it to a variety of fields including chemistry, finance, energy, and distribution. With this technology, the multiple basic circuits within the Digital Annealer that handle optimization processing can be given simple initial parameters and operated in parallel. Status control circuits installed outside the basic circuits observe the status during the performance of each basic circuit at a set frequency, enabling an efficient search for an optimal solution by adjusting the parameters as appropriate.

Using software developed by 1QBit (1QB Information Technologies Inc.), Fujitsu Laboratories evaluated the effectiveness of this technology in addressing actual use cases in the chemistry and finance fields. For molecular similarity comparison problems of below 50 atoms (chemistry), and a portfolio optimization problem for 500 stocks (finance), Fujitsu's Digital Annealer technology was able to shorten the preparation period required to find an appropriately precise solution in less than a day, compared to the previous requirement of approximately two weeks.

## Online resources

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- [Digital Annealer](#)

## Media Backgrounder: Digital Annealer

Fujitsu Laboratories Develops New Architecture that Rivals Quantum Computers in Utility (press release, October 20, 2016)  
<http://www.fujitsu.com/global/about/resources/news/press-releases/2016/1020-02.html>

- 1QB Information Technologies Inc.  
Fujitsu Laboratories and 1Qbit began collaborations in the AI field, including combinatorial optimization and machine learning, in May 2017.  
Fujitsu and 1QBit Collaborate on Quantum Inspired AI Cloud Service (press release, May 16, 2017)  
<http://www.fujitsu.com/global/about/resources/news/press-releases/2017/0516-03.html>