

CLARITY

A roadmap for the future of quantum computing

The D-Wave Clarity Roadmap

Even More Powerful Annealing Quantum Computers for Optimization

Addition of Gate-Model Quantum Computers to Expand Use Cases

New Classes of Quantum Hybrid Solvers, Finding Better Solutions, Faster

Cross-Platform Open-Source Tools for Both Annealing and Gate-Model Quantum Computers

Annealing Quantum Computers: Rapidly Bringing Even Better Solutions to Optimization Problems for Businesses Today

D-Wave will continue to invest in and further performance of the Advantage annealing quantum computer.

2023-2024:

Advantage 2™ quantum system will incorporate a new qubit design that enables **20-way connectivity** in a [new topology](#). The Advantage 2 QPU will contain **7000+ qubits** and make use of the latest improvements in quantum coherence in a multi-layer fabrication stack, further harnessing the quantum mechanical power of the system for finding better solutions, faster.

2025+:

Focused growth in qubit connectivity: improvements in qubit coherence will be harnessed to produce a series of increasingly connected quantum annealing processor topologies designed to bring additional customer value in optimization.



Gate-Model Quantum Computers: Expanding & Accelerating Quantum Solutions for Customers

D-Wave will apply its knowledge and nearly 20 years of experience in pioneering superconducting quantum annealing systems to build a scalable gate-model quantum computing technology in a multi-layer fabrication stack. Many efforts to develop gate-model quantum processors to date have focused on near-term success at the expense of scalability. In contrast, D-Wave is committed to focusing on the long-term vision of delivering a working technology at a scale that will bring value to industrial customers.

Phase 1:

Develop a gate-model qubit built in a multi-layer production stack, designed for scalability. Initially, D-Wave will validate and measure the multi-layer qubit design. Then the focus will be on verifying functionality of on-chip control devices for tuning and quantum logic using best practices developed in annealing quantum systems. The company will demonstrate the overall feasibility of qubit scalability to manage crosstalk and coherence issues for qubits near control devices.

Phase 2:

Demonstrate scalable logical qubits to deliver near-term engineering benefit and longer-term calculation benefit. Error-correction is a continuous tradeoff in which more physical resources increase the odds of a logical qubit surviving an error event. The target 60-qubit system will serve as a platform for validating on-chip, multiplexed control and the error-correction protocol in a single logical qubit.

Phase 3:

Demonstrate logical qubit manipulation. The target 1000-qubit system, to be fabricated on a single die, will be configurable as up to 4 error-corrected logical qubits. Developing scalable methods to control the interactions between logical qubits will be a critical step in preparation for the design of components for a full-scale gate-model QPU.

Phase 4:

Develop scalable task-specific components. Much like a classical digital CPU, a fully functional gate-model QPU will consist of many task-specific architectural components, including modules for state initialization, specific logic operations, data movement, and memory registers. Choosing to develop task-specific components earlier in the design process will lead to efficient control and improved scalability in the future.

Phase 5:

A general-purpose quantum processing unit (QPU). The modules developed in phase 4 will be combined on a quantum logic unit, that hosts things like memory, logic registers, shift registers, and state initialization tools. QPUs will be constructed by combining multiple quantum logic units. As user experience grows, the company anticipates rolling out successive generations of quantum logic units that are tailored to accelerate applications.



Powerful Hybrid Solvers: Exploiting Classical and Quantum Computation Methods to Find Better Quality Solutions Faster

The future of quantum computing is hybrid. D-Wave's delivery of performant, high-value solvers across multiple problem types will continue to expand and deliver the benefits of both classical and quantum resources for both annealing quantum computers and gate-model systems for emerging quantum use cases. These efforts will enable more customer problem types.

2022-2023:

Customers have a wide variety of problems they want to solve, many that are not easy to translate to the quantum system today. To reduce customers' effort and increase the types of problems that can benefit from quantum computing, D-Wave will introduce **new hybrid solvers to include mixed integer problems**, opening up a wider set of problems in drug trial optimization, logistics, scheduling, stock market optimization and trading, chemical process optimization, and more.

As in-production quantum applications expand and mature, customers will want to solve many different problem types within each application. D-Wave will add a **unified hybrid interface and a new portfolio platform** that incorporate the best solvers together for rapid application development, accelerating problem formulation, reducing time to development, and increasing problem performance.

2023-2024:

To enable the cross-platform initiative, the company will develop cross-platform solvers that can **bring the benefits of both annealing and gate-model platforms** to problem solution, in one solver service.

Today quantum computing is emerging in manufacturing and logistics, life sciences, mobility, and financial services. As vertical use cases mature, D-Wave will build **vertical solvers** designed to address the most common problem types in certain fields, accelerating the usage and adoption of repeatable quantum applications.

Cross-Platform Open-Source Tools: Powerful Developer Platform Enables Rapid Application Development

Customers benefit from the Ocean™ tools suite, an open-source collection of developer tools to build and run in-production applications. D-Wave will expand these and other resources in the Leap™ quantum cloud service to fully integrate annealing and gate-model quantum computing use cases.

2022-2023:

To prepare developers for D-Wave's upcoming gate-model product expansion, the focus will be on the **advancement of cross-platform tools** that can both educate developers on using different quantum systems and enable them to benefit from the familiar and robust Ocean coding environment, all in [one central location](#).

Additionally, developers will be able to access **code examples, gate-model simulators, and extensive documentation** to get started quickly on cross-platform solutions as part of Leap's Quantum Application Environment.



2023-2024:

D-Wave will further prepare developers for **annealing and gate-model quantum cross-platform readiness**. Illustrated demos, an [expanded problem inspector](#) for application development and de-bugging that incorporates both annealing and gate-model architectures, and cross-platform application examples will all be available.

Additionally, the first gate-model preview QPUs will come online in the Leap quantum cloud service, supported with a full suite of tools and resources.

Enhancements to the Leap Quantum Cloud Service: Expanding the Ecosystem & Production Applications

D-Wave will continue to expand the power of the Leap quantum cloud service for in-production applications. This will include new tools for fast deployment, administration resources, and enhanced service and support for enterprise, partner, and ISV service-level requirements.

2021-2022:

Enterprise customers and partners are building in-production quantum applications. To enable that progression and run global customers' at-scale applications, the Leap platform will incorporate **simplified customer benchmarking, expanded in-region systems** in North America and the [European Union](#), and **advanced administration**, including admin API access, and simplified deployment toolkits.

2023-2024:

As the quantum ecosystem expands, D-Wave will continue enabling ISVs and partners to include new **ISV "get started" toolkits**, and a robust **application marketplace** to easily find and share the best quantum applications. Continuing the focus on at-scale applications, the platform will incorporate **enterprise features like authentication** and will expand **in-region systems to Asia Pacific**.