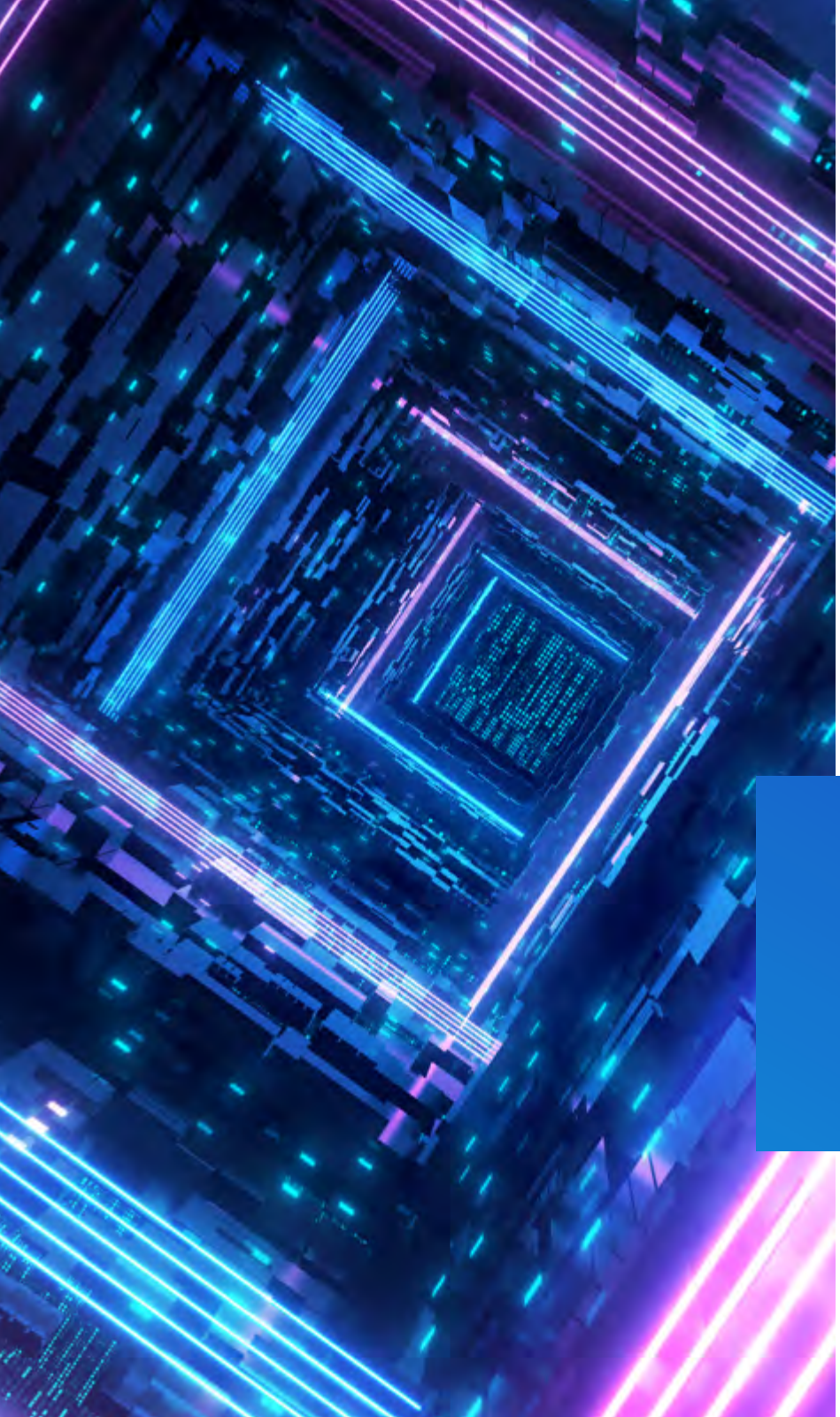
Digital Annealer / Quantum Inspired Optimization Services



Quantum Computing promises disruptive potential for certain problems that cannot efficiently be tackled with classic IT architectures. Such problems include decryption, simulation, and optimization tasks, but also demanding challenges in artificial intelligence. Quantum Computing relies on quantum mechanical effects such as superposition, entanglement, and tunnelling. Governments and industries around the globe are investing billions to exploit the competitive advantages offered by quantum computing. However, it will be years before quantum computers can solve industry-relevant problems. For example, to decrypt a message encrypted with a 2048-bit RSA key, quantum computers need about 20 million qubits[1] - current quantum gate systems are in the range of a few 100 qubits.

Among the quantum-relevant applications noted above, combinatorial optimization problems represent a large, industry-relevant application area. Here, the challenge is to find an optimal combination in a large search space resulting from the number of possible combinations.

Example: for a car in production, the PVC seals have to be made by robots.
A sealant can be injected from left to right or from right to left. One can start with the fifth seal and then the eleventh, or with the third and then the eighth. With seven seals to be drawn, there are approximately 50,000 possibilities. With 65 seals, the number of possibilities is already 2 * 10E108. What is wanted is the shortest way / time to make all seals. Classical approaches (especially brute force) reach their limits here.

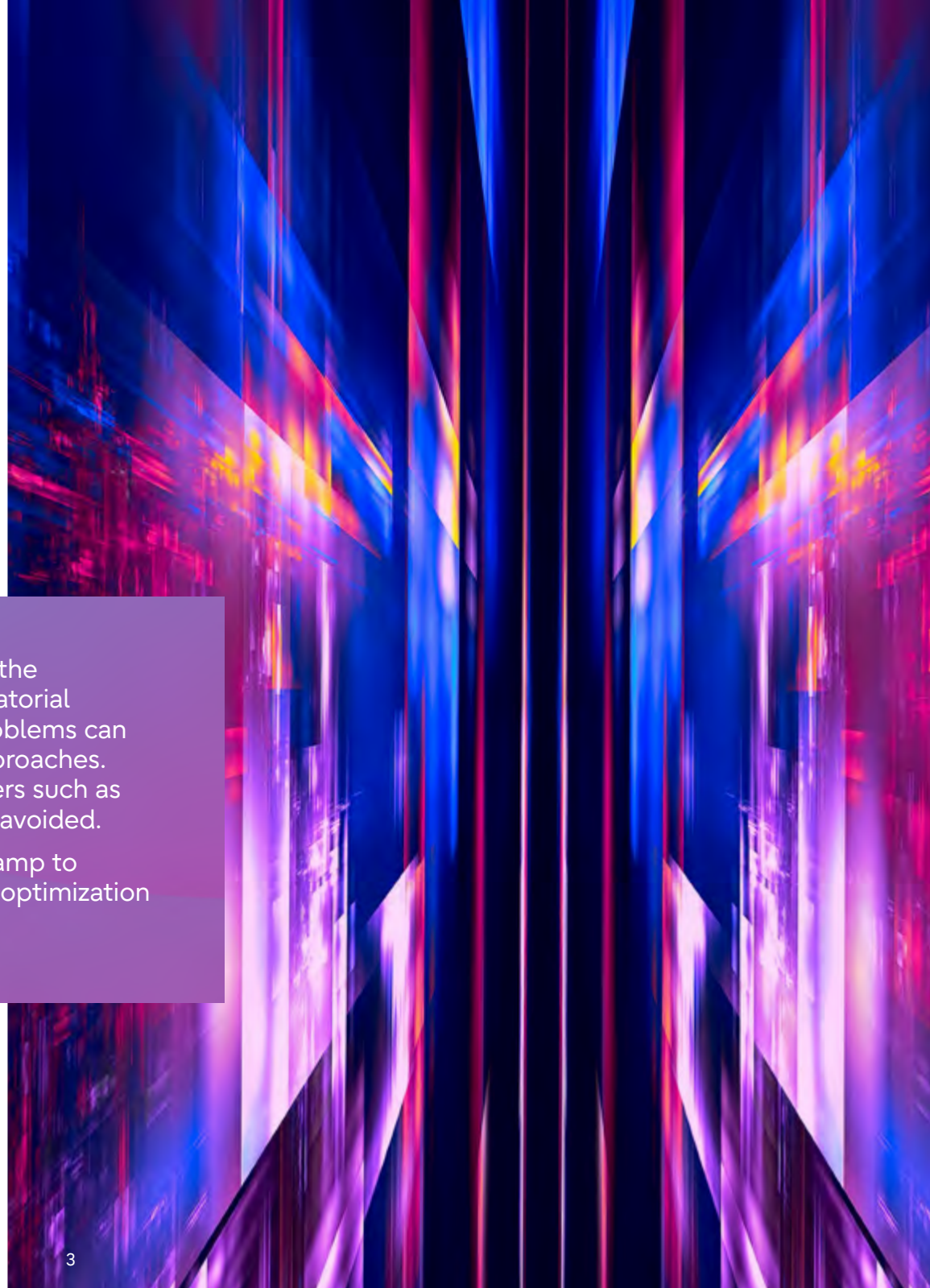
More than 60% of the practical applications for quantum computers presented by QUTAC[2] can be represented as optimization problems.

What makes Digital Annealer / Quantum Inspired Optimization Services so special?

The ‘programming’ of quantum computers is not done by re-compiling an existing, for example, C++ program, but by manipulating the quantum states. In the environment of combinatorial optimization problems, the problem is formulated as an ‘energy equation’ and Digital Annealer has the inherent logic to find the optimum solution of this energy equation[3].

Digital Annealer uses computational methods inspired by the principles of quantum mechanics for solving such combinatorial optimization problems. Based on a unique technology, problems can be solved up to 10,000 times faster than with classical approaches. At the same time, the disadvantages of quantum computers such as cooling to near absolute zero and the lack of maturity are avoided.

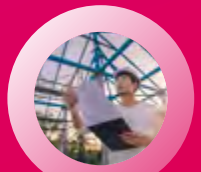
Digital Annealer is an actually available, future-proof, on-ramp to Quantum Computing for solving real-world combinatorial optimization problems today.



Real-world examples

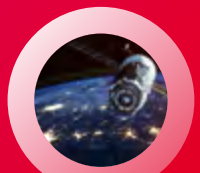
Hamburg Port Authority[4]: 20% improved travel times of trucks in the supply chain and 9% CO^2 reduction by optimizing traffic light switching in the overall network.

Deutsche Bahn[5]: Optimization of timetable request approval: Up to 10% more requests can be positively approved.



Field Service Management: Cut travel time by 25% with Fujitsu Field Force Optimizer[6].

Nippon Yusen Kabushiki Kaisha: Over 4000 working hours saved per year, with streamlined car carrier stowage planning operations[7].



UK Space Agency: Space debris removal[8].

How Fujitsu supports its customers

Fujitsu works closely with the customer throughout the whole process based on agile best practices.

In a co-creation workshop, business challenges are elicited and potential topics are identified:

- Those topics are jointly evaluated and prioritized in exploratory workshops. In addition to its technical expertise, Fujitsu contributes its in-depth experience from Digital Transformation projects in the Digital Annealer / Quantum Computing environment.
- Within the framework of a POC (Proof of Concept), a mutually agreed initial solution approach is implemented. The agile process allows to elicit enhancements or changes in the due course of the POC.
- Further development (minimum viable product) up to productive use.

Links

[1] https://quantum-journal.org/papers/q-2021-04-15-433/

[2] www.qutac.de/

[3] www.fujitsu.com/de/themes/digitalannealer/get-started/get-started-en.html

[4] www.fujitsu.com/emeia/about/resources/news/press-releases/2021/emeia-08122021-fujitsu-quantum-inspired-optimization-services-cut-traffic-jams-and-co2-emissions-at-hamburg-port.html

[5] www.youtube.com/watch?v=yZXhEFPtJeo

[6] www.fujitsu.com/us/microsite/flexforce/

[7] www.fujitsu.com/global/about/resources/news/press-releases/2021/0902-01.html

[8] www.fujitsu.com/uk/services/business-services/digital-annealer/cleaning-space/

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