Architecture of a quantum computing platform

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Nowadays there is a major effort worldwide toward scalable quantum computers and the quantum internet, with computer scientists, physicists and software engineers that are joining forces to realize this interdisciplinary work. Quantum computers promise new possibilities for solving computing-intensive or previously not efficiently solvable problems, however quantum processors can still be used only in restrictive laboratory conditions. Thus, it was a natural decision to propose a cloud-based access to the quantum computing devices and integrate them with a high-performance computing platform. This led to the new area of quantum programming and a rapidly increasing number of companies developing their own quantum computing platforms.

In this research we develop an architecture of a quantum computing platform with the cloud interface, that is based on the original model of the nanophotonic quantum processor with integrated quantum memory and a quantum transistor [1]. At the moment the platform works with an integrated quantum simulator that implements the behavior of the underlying model [2]. As shown earlier this model is universal, i.e. it is capable of performing arbitrary quantum computations. Additionally, it allows to speed up the implementation of controlled operations, that are heavily used in most multi-qubit algorithms.

The platform has two main components: the server-side framework and the client SDK, which makes coding quantum algorithms as easy as shown in the following example.

Listing 1: Example

```
conn = kmqc.connect(endpoint, user_id, api_key)
r = conn.execute(Program(
                    kmqc.gates.X(1),
                    kmqc.gates.H(0),
                    kmqc.gates.H(1),
                    kmqc.gates.CNOT(0, 1),
                    kmqc.gates.H(0)))
```

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References

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[2] Farid Ablayev, Sergey Andrianov, Danila Fetisov, Sergey Moiseev, Alexandr Terentyev, Andrey Urmanchev, and Alexander Vasiliev. Model of a programmable quantum processing unit based on a quantum transistor effect. *AIP Conference Proceedings*, 1936(1), 2018.