Depth-Driven Routing

A Novel Approach to the Qubit Routing Problem

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Sala Conferenze Emilio Gatti, Via Giuseppe Ponzio, 34/5

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Slides disponibili qui

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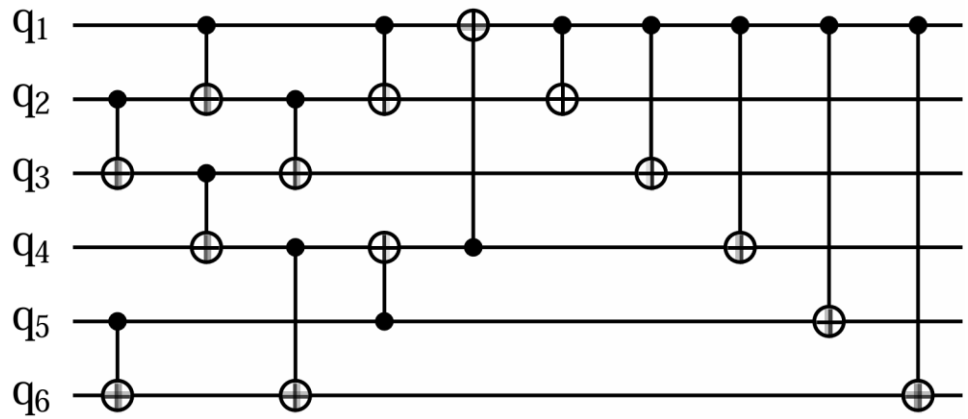
Qubits e circuiti quantistici

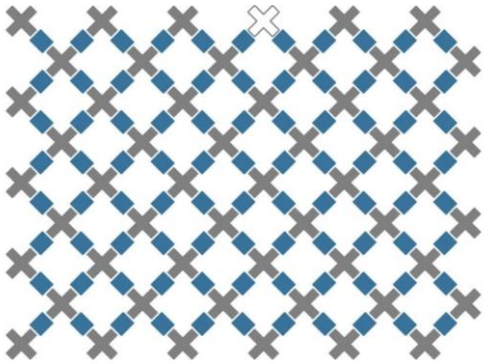
$$|q\rangle = \alpha|0\rangle + \beta|1\rangle$$

$$|\Psi\rangle = \sum_{i \in \{0,1\}^n} \alpha_i |i\rangle$$

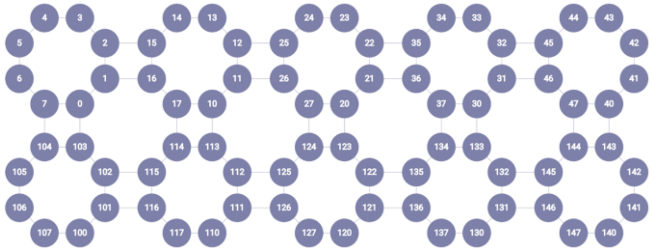


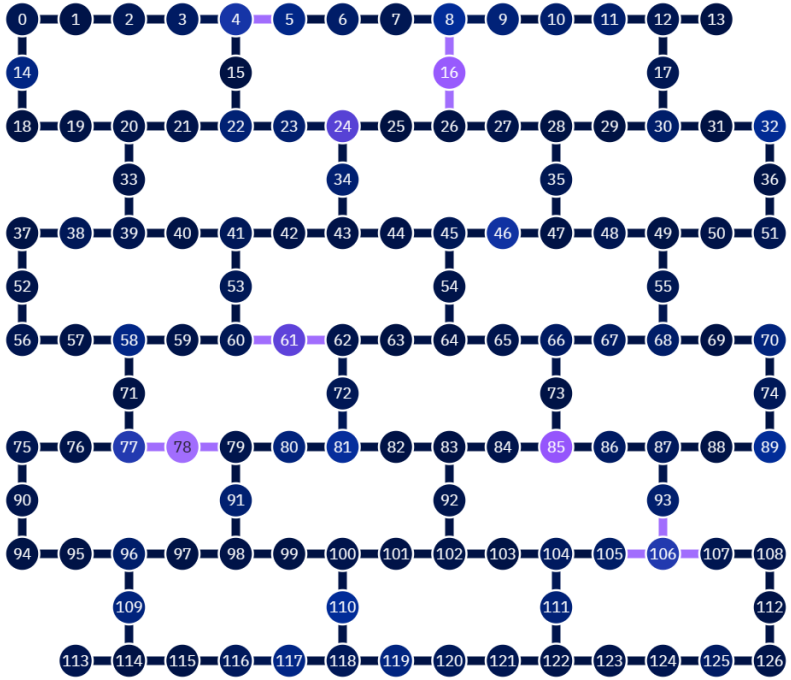
Quantum hardware

Google



rigetti

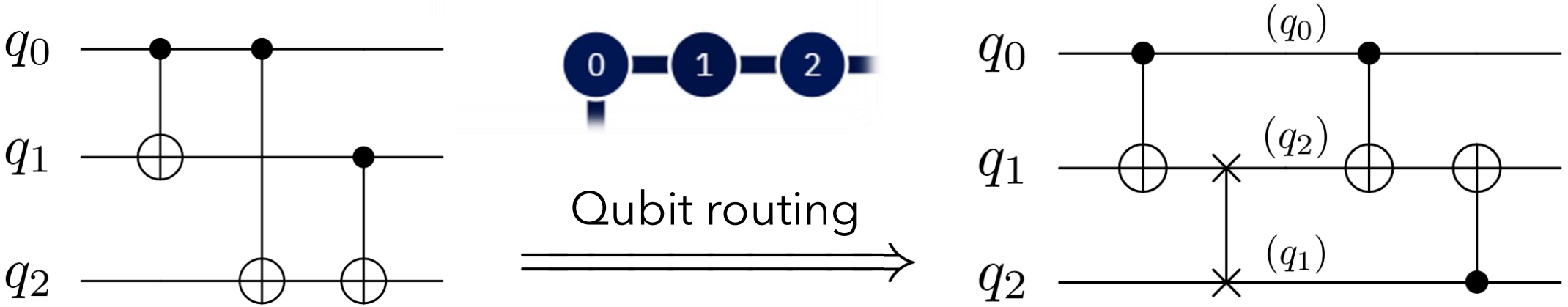




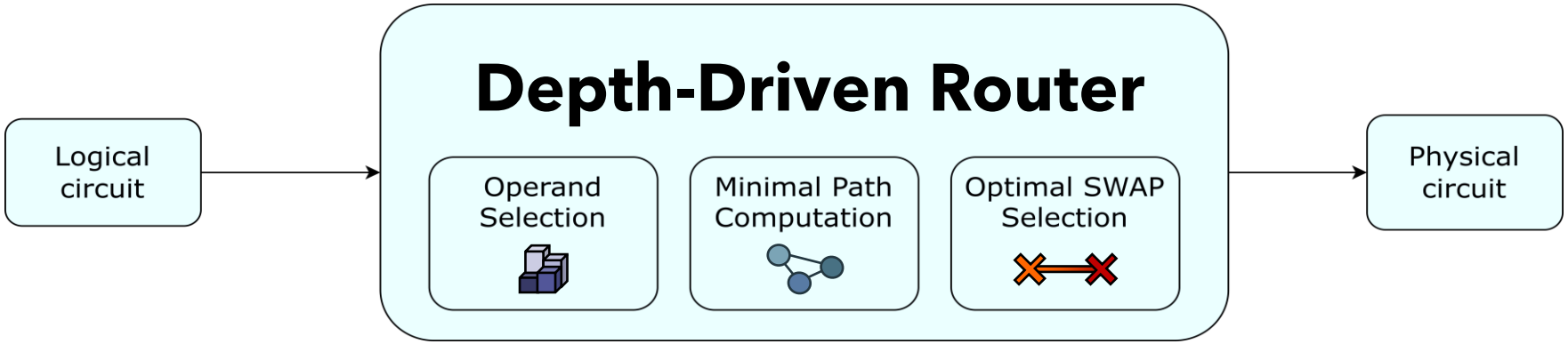
IBM

Google Sycamore: https://research.google/blog/quantum-supremacy-using-a-programmable-superconducting-processor/
Rigetti Aspen: https://investors.rigetti.com/news-releases/news-release-details/rigetti-computing-announces-commercial-availability-80-qubit
IBM Eagle: https://quantum.ibm.com/services/resources

Qubit routing



Depth-Driven Routing



Operand selection: selezione della coppia di qubit a cui applicare una SWAP

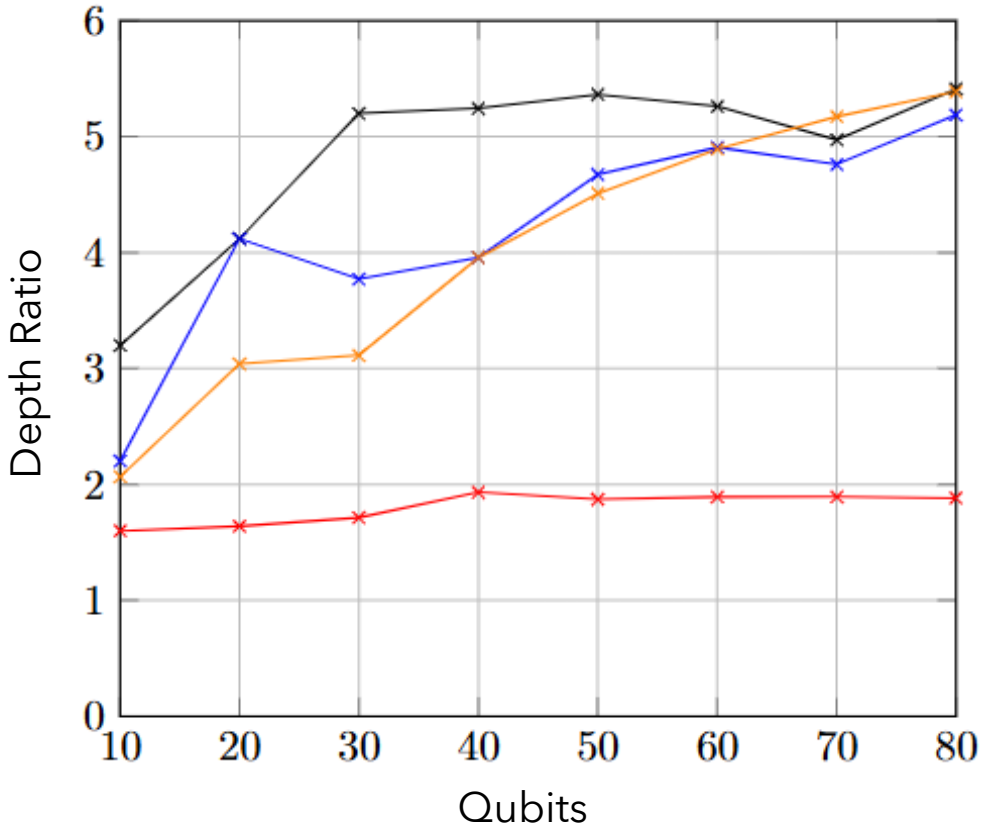
Minimal Path Computation: selezione del percorso tra due qubit in base a:

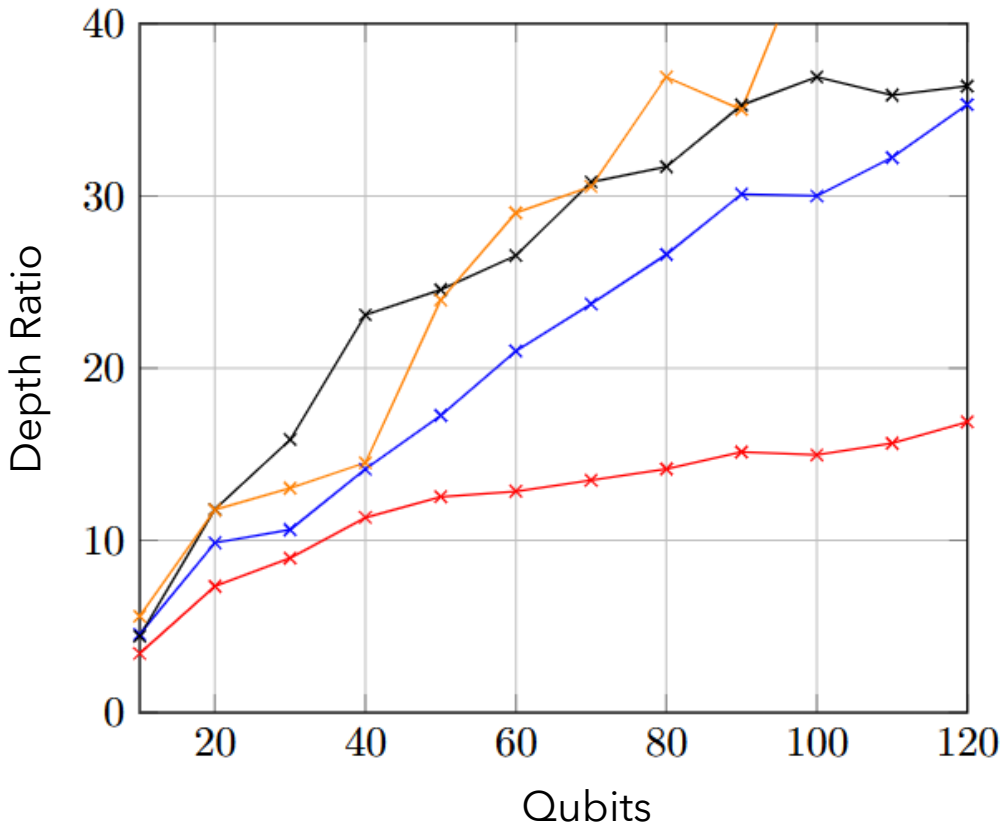
- Tempo di esecuzione
- Numero di SWAP richieste
- Lookahead

Optimal SWAP selection: la SWAP ottima viene applicata per avvicinare i due operandi

Risultati

$$\text{Depth Ratio} = \frac{\text{Depth finale}}{\text{Depth iniziale}}$$



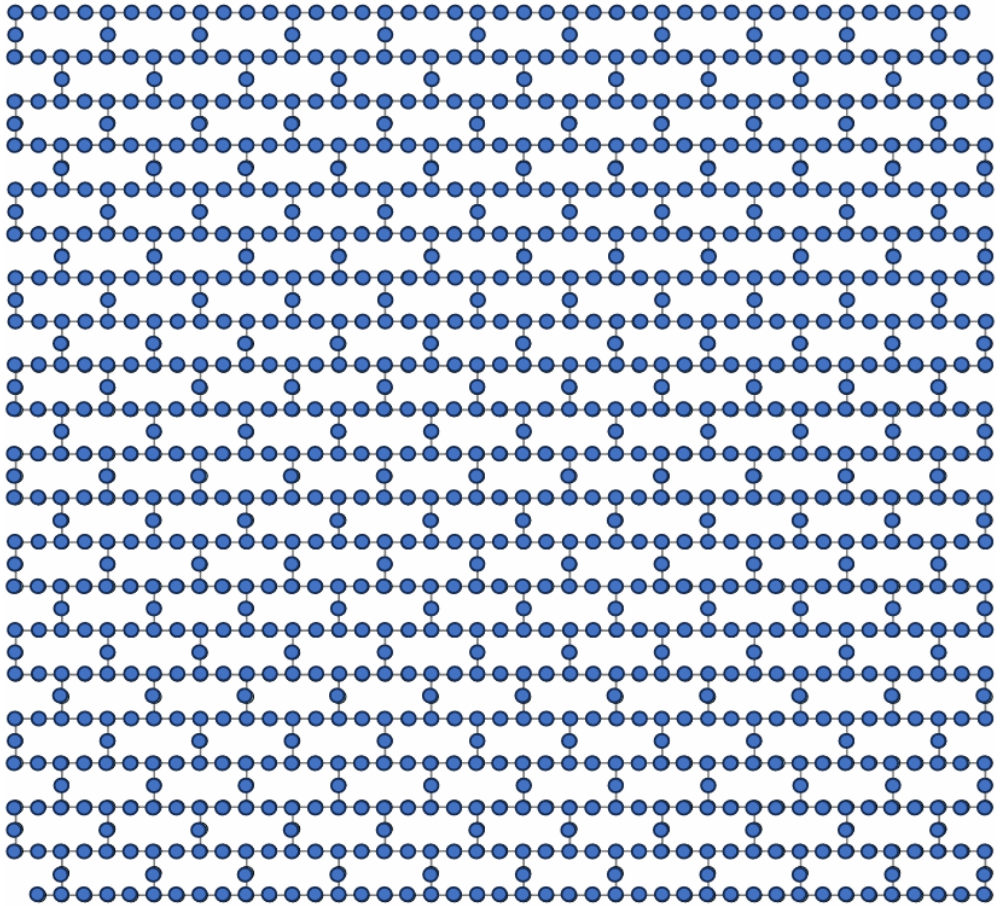


Topologia: Rigetti Aspen (80 qubit)
Circuito: Deutsch-Jozsa

Stochastic SABRE t|ket⟩ DDR

Topologia: IBM Eagle (127 qubit)
Circuito: Two-Local Ansatz

IBM Condor



IBM Condor: https://www.ibm.com/quantum/blog/quantum-roadmap-2033

Risultati

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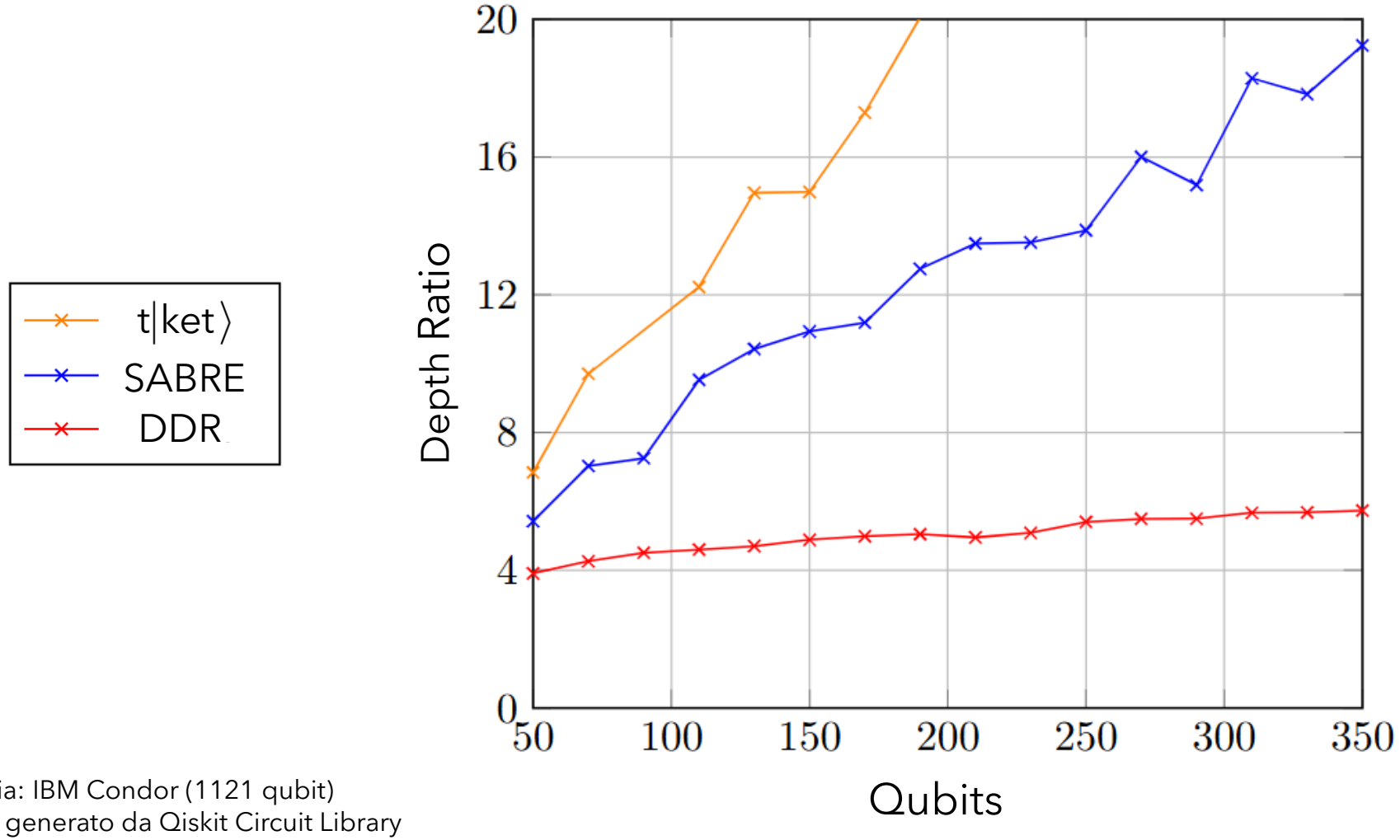

Topologia: IBM Condor (1121 qubit)
Circuito: generato da Qiskit Circuit Library

Grazie per l'attenzione!

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