Hacking Quantum Networks: Extraction and Installation of Quantum Data

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We propose the task of 'quantum hacking', which is the procedure of quantum-information extraction from and installation on a quantum network given only partial access. This problem generalizes a central topic in contemporary physics – information recovery from systems undergoing scrambling dynamics, such as the Hayden-Preskill protocol in black-hole studies. We show that a properly prepared partially entangled probe state can generally outperform a maximally entangled one in quantum hacking. Moreover, we prove that finding an optimal decoder for this stronger task is equivalent to that for Hayden-Preskill-type protocols and supply analytical formulas for the optimal hacking fidelity of large networks. In the two-user scenario where Bob attempts to hack Alice's data, we find that the optimal fidelity increases with Bob's hacking space relative to Alice's userspace. However, if a third neutral party, Charlie, is accessing the computer concurrently, the optimal hacking fidelity against Alice drops with Charlie's user-space dimension, rendering targeted quantum hacking futile in high-dimensional multi-user scenarios without classical attacks. When applied to the black-hole information problem, the limited hacking fidelity implies a reflectivity decay of a black hole as an information mirror.