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Secure network of entangled atomic clocks PETER KOMAR, Harvard University, MICHAEL BISHOF, University of Colorado, JILA, LIANG JIANG, Yale University, JUN YE, University of Colorado, JILA, MIKHAIL LUKIN, Harvard University — We propose a scheme for entangling atomic clocks separated by large distances using the concept of quantum networks. The protocol allows the clocks at different locations to be used in a network for a "supreme clock signal" with a stability set by the Heisenberg limit for the total number of atoms in the network. The realization we consider consists of multiple optical clock qubits at each location, as well as entanglement links created by sharing EPR photon pairs using quantum repeaters. We analyze the effect of local oscillator phase noise, time delays, and decoherence on the overall stability using different feedback schemes. We show that, for the current-state-of-the-art laser noise spectrum, the network is able to utilize a fully entangled GHZ state for a large number of clock qubits. We show that such a network can be made completely secure by preventing outside parties and individual participants from taking unfair advantage, while at the same time, providing access to the "supreme clock signal" for all honest contributors. Our protocol could serve as the backbone for a future global positioning system that will greatly surpass the accuracy and stability of the current GPS network.

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