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How Does My Cellphone GPS Work?–The Physics of Precision Time-Keeping

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The most precise measurements in all of science are frequency and frequency difference measurements, or alternatively, phase and phase change of electromagnetic waves. Improvements in time-keeping have opened up many horizons in fundamental and applied physics that range from the detection of gravity waves to the melting of glaciers and the depletion of underground aquifers. Precision time keeping has also had important practical applications such as in the navigation, beginning with the determination of the longitude position of sailing ships. We now use our cell phones to help us navigate city streets and hail taxis from Uber and Lyft based on our geographical position within a few meters. How did this come about? What will the new time-keeping technologies enable in the future?