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Advantages of Free Space Optics over Optical Fibre for Clock Tone Distribution in a 2.5 GHz Transmission Link

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Abstract content
   (Max 300 words)
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The Square Kilometre Array is a big data project across Africa and Australia. When fully operational, SKA will host the world's largest telescope with a combined signal collection surface area of about 1 km2, with distance up to 3000 km. The telescope rely on high clock tones to be distributed to each antenna and each clock signal is crucial for driving the digitizers, time stamping the data, and for monitoring and control functions. In addition to radio astronomy, other applications requiring high precision clock tones include banking systems, satellite navigation and metrology services. In the case of buried and aerial optical fibres, a complex interplay between numbers of factors adversely affect the stability in the light-wave clock tone as it propagates within an optical fibre. These factors include temperature fluctuations, component noise, polarisation instability, birefringence and others. Free Space Optics (FSO) presents some advantages over optical fibre – license free spectrum, quicker deployment and lower costs. However, the challenges experienced in FSO systems compared to optical fibre are atmospheric absorption and disturbances (fog, snow, rain), background light and requires line of sight. In this paper we present a detailed analysis of the advantages of FSO for clock distribution versus fibre transmission in the case of fluctuating temperature. The typical fibre has thermal coefficient of expansion of 7 ppm/°C. This means for 1 km length of fibre when the temperature changes by magnitude of 10 degree Celsius over a night/day cycle, the time of flight will change by 350 ps. This corresponds to a 19 degrees phase shift for a 2.5 GHz clock. The FSO system is far more immune to the temperature effects since the length of the medium remains unaffected.

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