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Establishment of primary national standard for time and frequency with internationally accepted performance

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Precise timing is a key requirement in space applications, satellite ranging, satellite navigation, communication networks, electrical power grids, financial networks and many other applications. Advancement of the science and technology creates the need of nanosecond accuracy of time in certain application fields. Also, the "Second" in International System of Units (SI Units), is involved in the definition of other SI units such as A, m, K, cd, kg, according to the new International System of Units (SI) definitions to be proposed to the General Conference of Weights and Measures (CGPM) by the International Committee for Weights and Measures (CIPM) at the end of 2018. Establishment of national time scale and frequency standards will be an activity for international recognition and future scientific and industrial requirement of precise time and frequency requirements in the country. In this research, a primary national standard for time and frequency was established using a commercial cesium atomic clock. Requirement for traceability of the standards was established through the common view techniques using a multi channel Global Navigation Satellite System (GNSS) time transfer receiver with choke ring type GNSS antenna. Reporting of comparison data was done using the protocol of the Consultative Committee for Time and Frequency (CCTF) Group on GNSS Time Transfer Standards (CGGTTS) format, to International Bureau of Weights and Measures (BIPM) daily to include in circular T of Key Comparison Data Base (KCDB) published by BIPM. Research includes the precise determination of the antenna location to millimeter accuracy, using GNSS Precise Point Positioning (PPP) processing of Receiver Independent Exchange (RINEX) Formatted observation files, Determination of Cable delay measurements of antenna cable and other cables in the system, Data logging and analyzing to determine characteristic behavior the Cs atomic clock, and steering and stepping the clock to achieve the internationally accepted variation limits of time with ± 10 ns per day and National Time Scale of Sri Lanka (UTC(SL)) difference with Coordinated Universal Time (UTC) called as UTC-UTC(SL) less than ± 100 ns. This work is about the achievement of the above requirements with better performance, with variation of limit of time less than ± 5 ns per day and UTC(SL)-UTC less than ± 50 ns with last 6-month data analysis and results published by BIPM circular T to confirm the performance and contribution of determining the UTC.

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