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A Method for Covert Monitoring of Heterogeneous Sensor Networks Based on Chaotic Dynamics - a cybersecurity perspective: synchronization, stealth, and reliability in distributed monitoring systems

Abstract

Distributed monitoring systems deployed in adversarial environments face a paradox classical security tools cannot resolve: the network must keep sensing, yet any predictable emission pattern becomes exploitable intelligence. Encryption protects message content, but not the act of transmission itself. This talk presents a method for covert monitoring of heterogeneous sensor networks based on chaotic dynamics — the Lorenz system. By seeding each node with unique initial conditions and deriving activation timings from a shared deterministic trajectory, the network becomes unpredictable to external observers while staying coordinated with its aggregators. We cover the mathematical guarantees ensuring the system remains bounded and never settles into predictable behaviour, the engineering trade-offs of real deployment, and parallels to resilience patterns already practiced in Site Reliability Engineering.