Methods and System for Synthesizing Cellular Network Traffic without Domain Knowledge

CPT-GPT is a transformer-based traffic generator that synthesizes realistic mobile core network control-plane traffic with high fidelity, enabling scalable and accurate simulation for 4G/5G network design, management, and performance testing.

Mobile core network (MCN) design and performance optimization require access to high-fidelity control-plane traffic traces, which are typically unavailable due to privacy and business constraints. Researchers at Purdue University have developed CPT-GPT, a transformer-based traffic generator that synthesizes realistic control-plane traffic without relying on domain-specific knowledge such as 3GPP state machines. Unlike traditional models (e.g., SMM) or GAN-based approaches (e.g., NetShare), CPT-GPT captures stateful semantics, multimodal feature relationships, and long-term temporal variations with high fidelity. Validated on a large LTE dataset from a major U.S. carrier, CPT-GPT demonstrates superior performance in semantic correctness, sojourn time fidelity, and transfer learning efficiency. This technology enables scalable, accurate simulation of MCN workloads, facilitating innovation in 4G/5G network design and management.

Technology Validation:

-Evaluated on 73M control events from 430K UEs.

-Reduces semantic violations by 2 orders of magnitude compared to GAN-based models.

-Matches or exceeds fidelity of domain-specific SMM models.

Advantages:

-No domain knowledge required (e.g., 3GPP protocols).

-High semantic correctness (0.2–1.5% stream violations vs. 22% for GAN).

-Efficient transfer learning (3.36× faster adaptation).

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Category

Artificial Intelligence & Machine Learning/Natural Language Processing & Generative AI Robotics & Automation/Simulation, Digital Twins, & Industrial Automation

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-Scalable to arbitrary dataset sizes.

-Avoids memorization of training data.

Applications:

-MCN performance benchmarking.

-4G/5G core network design and simulation.

-Real-time network management and telemetry.

-Autoscaling and fault resilience testing.

-Academic research in mobile networking.

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