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**Performance Specification and Evaluation with Unified Stochastic Probes and Fluid Analysis**

**Abstract:**

Rapid and accessible performance evaluation of complex software systems requires two critical features: the ability to specify useful performance metrics easily and the capability to analyze massively distributed architectures, without recourse to large compute clusters. We present the unified stochastic probe, a performance specification mechanism for process algebra models that combines many existing ideas: state and action-based activation, location-based specification, many-probe specification, and immediate signaling. These features, between them, allow the precise and compositional construction of complex performance measurements. The paper shows how a subset of the stochastic probe language can be used to specify common response-time measures in massive process algebra models. The second contribution of the paper is to show how these response-time measures can be analyzed using so-called fluid techniques to produce rapid results. In doing this, we extend the fluid approach to incorporate immediate activities and a new type of response-time measure. Finally, we calculate various response-time measurements on a complex distributed wireless network of O(10129) states in size.