DIFFUSION SYSTEMS

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Abstract: This talk extends a formal model of computing based on location based diffusion communications introduced some years ago[1,3]. In this model directed broadcasting communications, instead of largely used point-to-point communication schemes, are the unique interaction primitives. For this model we have developed a process calculus for reconfigurable communicating systems based on mobile processes. We have provided a full operational semantics for this calculus [2,3] and we illustrate its expressiveness through some examples taken from complementary classes of applications.

The primary goal of this model is the design of correct distributed systems of interacting mobile objects. We give in this talk the main features and advantages of using such a computing communication model for future interacting objects in adaptive systems.

Then, we use a restricted diffusion scheme for constructing correct routing functions for mobile processes in general interconnected networks. We present a new model of routing messages in ad-hoc networks that allow mobile processes to communicate without explicit knowledge of their actual location. The management of the process location is done at routing level, and we present for this new model routing functions that are proved correct and valid for any connected (reconfigurable) network.

We prove that these functions verify two important correction criteria: validity and deadlock avoidance for any network interconnection topology. We demonstrate a good trade-off between the length of resulting communication paths and the number of nodes that are to be notified for each process migration. We also provide a way to represent routing information to drastically reduce the overhead of memory space required when the routing model is implemented with a deterministic or an adaptive routing approach.

Finally, we will set the basis for secure communicating systems using a notion of separable broadcasting communicating systems as well as anonymous communicating objects. We propose to build an infrastructure for securing the design methods for communicating systems of embedded networks deployed in untrustworthy or hostile environments.

To design, build and evaluate this infrastructure we conduct research in different areas: intrusion modeling and detection (e.g. applied to smartcards), embedded kernels security, network routing security, anonymity and privacy models for mobile and diffusing computations for critical application deployment.

Keywords: *diffusion computing, mobility, routing, security, formal model*

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