Advance Access published on January 23, 2006
doi:10.1093/comjnl/bxh163

Editorial: Building Adaptivity into Computer Networks

EROL GELENBE[1]*

[1]*Dennis Gabor Chair, Imperial College, London*
**Email: e.gelenbe@imperial.ac.uk*

The number of nodes that our global Internet supports will rapidly move from the hundreds of millions to the hundreds of billions. Sensor networks, smart dust, on-board networks in personal vehicles, networked letters, packages and clothes, will all contribute to this growth. While elements of top-down and well organised design will still be an important element of these future complex computer systems, many systems will have to interact in an ad hoc manner in order to offer fast access and services when fully organised and completely reliable information is not available.

This collection of articles, which are broadly in the emerging area of Autonomic Networks, address some issues that are relevant to this broad agenda, going from the 'upper and user' end of networks all the way down to the hardware of routers.

The paper by G. Rubino's group at IRISA Rennes addresses how Quality of Service (QoS) can be measured in a manner which is compatible with a human user's perception. Clearly one cannot have human users acting as 'quality control monitors' across the Internet. On the other hand, if we can dispose of an algorithm that inputs objectively measurable QoS (such as packet loss) indicators and provide a resulting estimate about how a human user might react to the resulting, for instance, video sequence that is received from the network, one could then evaluate whether the network is doing its job properly. The IRISA group describes an approach that uses the Random Neural Network trained to provide user-oriented quality predictions from measured QoS metrics. The results are tested in a variety of practical settings. The work by J. Pitt and his colleagues considers voting based protocols in ad hoc networks. Voting can be used in many contexts where some form of distributed decision making is needed, both for the management of resources, or for allocating degrees of trustworthiness to certain agents, or to take a decision in a distributed electronic environment. The paper by R. Lent considers how highly distributed ad hoc networks may be evaluated during the design and development phase; he suggests techniques that combine the physical characteristics of the network, as well as its software and the users' characteristics within one unified and flexible simulation environment. The paper written by A. Gyorgi and G. Ottusak considers the question of routing, when pre-existing information does not exist. This theoretical paper considers methods, similar to the ones that have been implemented in Imperial College's Cognitive Packet Network test-bed [1,2,3], to make routing decisions based on the success or failure of past routing decisions. They show that such decisions, if properly defined, can converge to the optimal decisions in some precise mathematical manner. Finally, the work by T. Koçak considers how the Random Neural Network can be imbedded in a hardware router to obtain fast and smart routing decisions. This paper discusses routing hardware which is being developed for the Cognitive Packet Network.

We hope that by discussing research that is relevant to the application end of networks, down into the routing layer, and into the routing hardware, these papers will illustrate some of the ideas that may allow us to design and evaluate the massive, mobile and dense autonomic networks of the future.

REFERENCES

[1] Gelenbe, E., Lent, R. and Xhu, Z. (2001) Measurement and performance of a cognitive packet network. *Journal of Computer Networks*, **37**, 691–701.

[2] Gelenbe, E. (2004) Sensible decisions based on QoS. *Computational Management Science*, **1**(1), 1–14(2004).

[3] Gelenbe, E., Gelenbe, E., Gellman, M., Lent, R., Liu, P. and Su, P. (2004) Autonomous smart routing for network QoS. In *Proceedings of First International Conference on Autonomic Computing*, pp. 232–239. IEEE Computer Society Press.