From the Editor-in-Chief . . .

THE TRUE MEANING OF ANALOG

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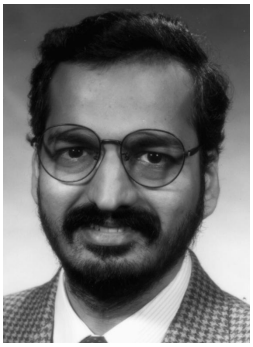

Interaction pervades the Internet. Not only its newest applications but also its infrastructure are inherently interactive. When you buy a book over the Internet, you interact at the application level; when your router forwards along a packet, it interacts with its peers. However, these interactions are not especially sophisticated—query-response in the first case and forwarding in the second. Therein lies the problem.

The paradox of Internet computing is that although the Internet requires interactivity and the underlying technology can support it, our architectures and paradigms are still based mostly in design for isolated activities. Any interaction is of the least-common-denominator variety.

Documents as Communication

A simple example of interaction, related to the present theme issue, occurs in the notion of documents, which underlie much of what happens in the Web. Documents used to be just pieces of text, typically tied to a specific presentation and to the physical medium of paper. The arrival of hypertext and its realization on the Web opened documents up to varieties of structure and to the separation of content from presentation, and presentation from the physical medium.

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Well, almost. As a community of techies, we haven't quite separated content from style and we haven't quite nailed down the metadata. But, as the present issue shows, we are making progress.

Let's step back and consider what documents really are. They are not just bytes or files, but ways of communicating. As currently realized, documents are a peculiar way of communicating. Someone viewing a document is essentially subjected to a long, possibly annoying monologue.

To become analogs of real human communication, documents should be modeled as dialogues: They should be interactive, be presented incrementally, and carry a deep argument—rhetorical—structure.

At the same time, they ought to go beyond usual verbal communication, because unlike normal human conversation, documents are meant to persist and to be communicated or "played back" in different contexts. The viewers of a document may have different needs for information and may be working on platforms of different connectivity.

For instance, imagine a document consisting of a variety of media types: text, video, or whatever. The document might be making an argument, say, about the weather in the Raleigh area. Based on the structure of the argument, the available bandwidth, and what the viewer cares about, the document might be streamed and presented as a set of temperature ranges, textual excerpts from magazines, still images, or videos. The document will reflect its author's opinions and arguments, but in ways that make the most sense to its readers. It is in the author's interest to be understood and to convey meaning to the readers with the least effort by either party.

Flexibility in presentation and sensitivity to the context of use not only benefit human users—authors and readers alike—but also benefit providers of infrastructural services in helping deliver higher quality service without additional communications requirements. Although the above capabilities require a certain level of agreement or standardization, they are not fundamentally beyond today's technology.

Being Analog?

One kind of interaction is when a computation relates to, or is analogous to, some part of the world. The word "analog" brings up visions of continuously varying variables and their presentation,

as in analog watches. Analog interfaces are fine. However, I would like to emphasize the original idea of analogy, which was the basis for the term analog and which means a lot more than "not digital."

In analog computing, the computation—or system of differential equations—was designed to be analogous to some process in reality. Because an electrical circuit can be characterized by the same equations as those used in a mechanical system—say, one involving springs and weights—the electrical circuit is analogous to, and can be used to emulate, the behavior of the spring mechanism. The circuit is thus an analog computer.

Digital technology—resistant to error, easily customizable, and cheaper—has eliminated analog computers as a computing medium. However, all computing remains analog, in the sense of modeling reality. Traditional computing could sustain the polite fiction that it was simply disembodied symbol processing, because isolated components could be modeled simply as stateless mathematical functions. The open, flexible Internet world has little use for such a fiction. Internet computing may be symbolic, but disembodied it isn't. Noninteractive—read stateless, context-independent—abstractions have only limited use over the Internet. Whether it is a device or a program, if it doesn't interact, it's as if it isn't there at all.

Interactive All Over

The key question for Internet computing is not going to be how a computation is physically realized but how it interacts. The interaction metaphor applies to application scenarios and to every layer of the infrastructure. From host configuration to active networks to adaptive routing, the trend in abstractions for programming is toward increasingly dynamic interactions.

We'll be looking at the implications of these ideas in the new year of *IEEE Internet Computing*. ■

Farewell to Charles Petrie

With this issue, *IEEE Internet Computing* bids farewell to its first editor-in-chief, Charles Petrie, who brought energy, vision, and a genuine passion for the Internet to the first two years in the difficult task of starting up a magazine. He will remain on the editorial board as EIC emeritus. Petrie is succeeded by Munindar Singh, former associate editor-in-chief, who was appointed EIC by a vote of the Computer Society's Publications Board last fall. His two-year term began 1 November 1998. Robert Filman was appointed associate EIC.

On pages 94-95, you can find short biographies for *IC*'s 1999 Editorial Board. Our newest board members, appointed by Singh, are introduced on page 8. They are Li Gong, head of the security and network group at Sun Microsystems, and Fred Douglis, head of the Distributed Systems Research Department at AT&T and liaison to the Computer Society's recently constituted technical committee on Internetworking.

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New Editorial Board Members

Two new members joined the editorial board of *IEEE Internet Computing* in January 1999.

Li Gong is chief architect, a distinguished engineer, and manager of the security and network group at Java Software, Sun Microsystems Inc. He serves as associate editor of *ACM Transactions on Information and System Security* and is on the editorial board of the *Journal of Computer Security*. He was program chair of the IEEE Symposium on Security and Privacy, the ACM Conference on Computer and Communications Security, and the IEEE Computer Security Foundations Workshop.

Gong received the BS and MS degrees from Tsinghua University, Beijing, China, and the PhD degree from the University of Cambridge, England. He was awarded the Leonard G. Abraham Prize by the IEEE Communications Society in 1994.

Fred Douglis is the head of the Distributed Systems Research Department at AT&T Labs—Research. He has published several papers in the area of Web performance and is responsible for the AT&T Internet Difference Engine, a tool for tracking and viewing changes to resources on the Web. He is the chair of the IEEE Computer Society Technical Committee on Internetworking and of the 1999 Usenix Symposium on Internetworking Technologies and Systems.

Douglis has taught distributed computing at Princeton University and the Vrije Universiteit, Amsterdam. He has a PhD in computer science from the University of California, Berkeley.

Short biographies for other members of the 1999 Editorial Board are on pages 94-95.

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