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[TITLE]

Elucidating the intriguing behaviors exhibited by the Internet

[MAIN BODY]

The Internet is connected with countless information processing devices, including personal computers. However, only a set of simple rules is specified for using the Internet for the transmission and reception of information. Individual devices follow these rules to perform communication anytime with any device for any length of time. Hence, there is no system that allows anyone to directly control the entire Internet. Each element constituting the Internet communicates with others individually. In fact, the Internet is an autonomous distributed system formed by many such devices. It is now known that, when individual devices perform their own operations on the Internet independently of one another, the Internet exhibits very interesting behaviors as a whole. I was intrigued by such phenomena and began research into them.

A pattern in communication traffic fluctuation

An example of such phenomena is $1/f$ fluctuation. Measurement of Internet traffic shows a fluctuation with a cyclic increase and decrease. This fluctuation follows the rule of $1/f$. The same fluctuation pattern can be seen not only in the natural world but also in our biological functions, such as heartbeats and brain waves. Isn't it interesting that devices that are operating independently on the Internet exhibit a pattern as a whole that is similar to a human biological function? Investigation into the mechanism of this fluctuation in the Internet is one of my research interests.

The key to understanding the fluctuation in the Internet is to analyze the rules used for communication. Each rule is very simple, such as "if there is no response to the information

sent after a set period of time, send the information again.” Even if the input of information to be communicated is random, the exchange of information conducted in accordance with the set rules results in a nonrandom fluctuation as a whole. I am attempting to clarify which parts of the rules contribute to the occurrence of the fluctuation.

Enabling control of the Internet

One of the most fascinating aspects of this research is that locally applied rules determine the overall behavior of the entire Internet. What’s more, by understanding the mechanism of the fluctuation, these locally applied rules can be redesigned to enable indirect control of the entire Internet. This is also an interesting aspect of the Internet, as it is not possible to attempt such a thing with a human body.

This research is very rewarding because it will allow us to better understand the inner workings of the Internet, which has grown too large for us to understand exactly what is happening within it, and may even allow us some measure of control over the entire Internet. I believe that this research will eventually shed some light on how the activities and emotional states of humans are projected onto the Internet, and I believe that knowledge will open up a whole new world for exploration.

(Interviewed and summarized by Osamu Nakamura)