



Emergent Properties, Human Rights, and the Internet

Vinton G. Cerf • Google

Chaos theory tells us that computable order sometimes exists in seemingly random and chaotic systems. *Emergence* is a process through which properties not apparent in individual elements become apparent in consequence of aggregation. Emergence is a function of collective behavior and isn't always predictable, even though the individual elements' properties are well known. Snowflake structure is a common example: we know from the water molecule's properties that crystals will form at certain temperatures, but we can't predict the pattern and shape of the crystalline flakes.

I had a recent experience that struck me as an extremely simple example of emergent behavior. I was trying to fill a pepper grinder with peppercorns. Because I usually make a mess of this, with peppercorns spilling everywhere, I decided to use a funnel. I poured the peppercorns into the funnel, and they instantly jammed up. Not one peppercorn made it into the pepper mill. If I had put them in one at a time, it would have worked, albeit slowly. But pouring a bunch in at once caused them to form an immovable block — partly because the friction of each peppercorn's rough surface prevented the peppercorn nearest the mouth of the funnel from slipping through it, releasing the next one, and so on.

As I thought more about the notion of aggregate behavior, it seemed to me that the Internet is a good place to look for more examples. Semiconductors' properties let us make chips that manipulate binary quantities. Out of this, we make computers that we can program. The programs and their behavior aren't predictable purely from silicon's properties or even the complex functions of the processing units we build. In some sense, too many possibilities are inherent in the configuration of memory and

processing that each chip offers. We make operating systems that become platforms for more complex applications. We build networks and interconnect the computers with them, creating ever more elaborate platforms. We build distributed processes that we can form into clouds of computers that, in turn, support billions of user interactions. To this we add mobile access with devices that act as platforms for applications that are amplified via the Internet's cloud computing systems. At every level of abstraction, we encounter emergent properties that exhibit behaviors that aren't predictable purely from the level below. The whole is greater and more complex than the sum of its parts.

In a recent op-ed, I took the position that access to the Internet shouldn't be elevated to the status of a human right (*New York Times*, 4 Jan. 2012). An avalanche of comments resulted, some positive, some negative. It became clear from the discussions around the net that many people felt strongly that access to this information-sharing system was extremely important to the patchwork quilt we call our global society. Is it possible that the Internet and all the applications it supports now, and might support in the future, represent an indispensable tool for exercising our human rights to expression and assembly? Certainly, many who blogged, tweeted, emailed, and commented felt strongly that denying people access to the Internet should be treated as a human rights violation.

In debates about abusive behavior on the Internet, some proposals were labeled “three strikes and you're out,” applying the rules of baseball to abuse of the net. Spammers, pirates, bullies, and other miscreants would have their Internet access cut off if they were caught a

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third time violating legal or social norms. Others took the view that this was too severe, and that Internet access has become too important and too critical to our lives to permit such drastic action (to say nothing of trying to enforce it).

I concede the point that the Internet has become an increasingly valuable tool in everyday living for the 2 or perhaps 3 billion souls privileged to have access. Whether we should conclude that it's a human right, in and of itself, might still be fairly debated. Although Internet access might not reach the level of food, clothing, and shelter, some could argue that denying access to it, when access is available, is itself too extreme. In short, the importance of access to the Internet might be an emergent property of its capacity to support the myriad uses to which it's now being put.

Interestingly, the rights to speak and assemble are themselves emergent properties of societies. In isolation, these rights aren't meaningful. Only in the presence of aggregations of humans — that is, societies — do they become important. We label these objectives "human rights" because we find them to be important features of the societies we find most desirable. We adopt these as principles for shaping the societies in which we want to live. Because of their importance, we also prioritize the provision of access to tools that let us exercise these rights we deem to be essential.

We might adopt a goal that everyone should have access to the Internet, and this has been a personal goal for me. Although it might not elevate the Internet, or access

to it, to the level of fundamental human right, it suggests that working toward global reach is a worthy objective. Someday, however, something better will be invented, and a new goal will be global access to this new system. As I tried to suggest in the *Times* op-ed, I'm not sad or affronted that I don't have a horse today. A horse might once have been indispensable for making a living, but it's been replaced with several hundred horses under the hood of my car in the garage that, itself, has replaced the barn. □

Vinton G. Cerf is vice president and chief Internet evangelist at Google. Contact him at vint@google.com.

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