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DIGITAL STRATEGY

WEAPON OF MATH

DESTRUCTION

A simple formula explains why the Internet is wreaking havoc on business models. **BY DAVID P. REED**

Conventional wisdom is that a remarkably powerful effect known as Metcalfe's Law is driving the growth of the Internet. The law says that the value of a network grows in proportion to the square of the number of users, which means that, once a network achieves a certain size, it becomes almost irresistibly attractive. But Metcalfe's Law actually understates the potential value of the Internet, and by a huge margin.

I'd like to suggest a new way of looking at the economics of the Internet. I think my approach can explain why forecasters have so consistently underestimated its growth. (And, believe me, they have: In 1995, estimates for on-line commerce in 1998 were \$2 billion to \$3 billion, while the real number turned out to be more like \$13 billion.) My approach not only should add to the urgency that businesses feel about moving on-line but also helps identify which on-line strategies will work and which will fail.

It helps to first understand the two laws of networks that have been around for some time. First is what might be called Sarnoff's Law, after the pioneer of the broadcast industry. This law says that the value of a network grows in proportion to the number of viewers.

Second is the law named after Bob Metcalfe, the inventor of the Ethernet computer-networking technology. He reasoned that 1,000 people on a network can have roughly one million different conversations, so he said the value of a network grows in proportion to the square of the number of users. The n^2 value explains the growth behavior of networks, such as phone systems or electronic-mail systems, that are mainly used for one-on-one communication. The n^2 effect says that, given the choice of joining a large existing network with many users or an incompatible new one with few users, new users will almost always decide that the bigger one is far more valuable. The result is often explosive, accelerating growth once a network establishes dominance. This behavior explains why there is now one global e-mail system, while just a few years ago there were thousands.

There's an additional law at play with the Internet because it facilitates the formation of groups, in a way that Sarnoff and Metcalfe networks do not. The number of groups that can be formed

over the Internet isn't the Sarnoff n or Metcalfe n^2 . It's 2^n by the time you add up all the possible two-person groups, three-person groups, etc. So, the value of the Internet grows in proportion to 2^n . Let's call this effect the Group-Forming Law.

This law is so powerful because 2^n gets impossibly large very fast. There's the old story about the king who rewarded a wise minister by offering him anything he wanted. The minister said all he wished for was two copper coins on the first square of a chess board, four on the second, eight on the third, and so on—a progression based on 2^n . The king protested that the minister should ask for gold or pearls, not copper. But, by the time the 8,192 coins were placed on the 13th square, the king realized he'd been had— 2^{64} ; is more than 18 quintillion, which, if memory serves, is more grains of sand than exist in the world. (The story has it that the king had the minister beheaded for being a wiseguy.)

All three laws, in fact, apply to the Internet. Services such as news sites that are aimed at individuals benefit from additional users in a linear, Sarnoff way. Services aimed at facilitating transactions, such as many commercial sites, benefit in an n^2 Metcalfe way. Services aimed at building communities, such as AOL, benefit in a 2^n , Group-Forming way. What's important is that the dominant value in a typical network tends to shift from Sarnoff to Metcalfe to Group-Forming as the scale of the network increases. So, as the Internet continues to expand, investments in Group-Forming networks are likely to produce the biggest returns.

As the scale increases, what's important also shifts. When Sarnoff's Law dominates, content such as TV programs is king. When Metcalfe's Law kicks in, transactions are king. When the Group-Forming Law takes hold, communities are king. The value in a Group-Forming network is constructed jointly, whether through discussion groups, through joint plans to buy something in bulk at low prices, or through some other means.

But the theory is less important than the practice, at least if you're trying to profit from the Internet, so I'll make some predictions based on the likely effects of the Group-Forming Law:

■ The obvious conclusion is that whoever forms the biggest, most robust communities will win. But the Group-Forming idea can be used to look well beyond the obvious and discriminate among strategies that are all billed as building communities. For instance, Internet auction pioneer Onsale, which buys closeout products and auctions them on its Web site, will see its value rise only in proportion to the number of users. On-line classifieds, which connect buyers to sellers on a peer-to-peer basis, should see a stronger, Metcalfe effect. Ebay, which began as one person's attempt to establish a market for Pez candy dispensers, should get an even more powerful Group-Forming effect because it helps members act in groups as they auction off and bid for products on-line. (Other economics work in favor of Ebay, too. Because the Group-Forming effect will give it enormous volumes of business, it can charge a lower commission on sales. The low fees will attract more users and produce a virtuous circle. Also, because it's Ebay's customers who do the selling, Ebay doesn't face any inventory or product-development issues.)

■ The demand for Group-Forming capabilities will change the winners and losers in technology. IBM subsidiary Lotus, the pioneer of enterprise groupware, has a hard time supporting ad hoc groups that span multiple companies. So, Lotus will achieve little Group-Forming value. By facilitating easy ad hoc creation of "teamrooms" by any group of Internet users, Instinctive's eRoom and Excite's Excite Communities, among others, seem likely to overwhelm Notes and capture big chunks of the groupware market.

■ The value of merged networks, through deals such as the Yahoo takeover of GeoCities, may be much greater than it might seem. Say the networks each have five users. The value of their merger isn't just the number of users in each network added together (10) as Sarnoff's Law would imply, or even a function of the number of users multiplied by each other (25), as Metcalfe's Law would imply. The value instead follows a 2ⁿ Group-Forming effect, so it equals 2⁵⁺⁵, or 1,024.

■ As digital networking brings scale and global reach to all aspects of our lives and activities, many established business patterns will be threatened. For example, health-care networks may move from treatment transactions to collaborations around disease management.

■ The community idea applies to every company, because every company can establish powerful communities by sharing information among its suppliers, distributors, and customers and can figure out ways to collaborate with them on new products and services. This last may be the most important because it shows how everyone can translate my general observation into the only economics that matter: the bottom line.

*Dr. Reed, a consultant and entrepreneur believes the best way to predict the future is to build it. He can be reached at dpreed@reed.com. For a fuller treatment of the mathematics and logic that justify Dr. Reed's new law.[see] *Reed's Law: That Sneaky Exponential—Beyond Metcalfe's Law to the Power of Community Building*.*

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