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THE FUTURE OF THE INTERNET

Two computing behemoths have big information technology plans for the future

Interviews with Microsoft's Lewis Shepherd, Google's Vint Cerf

By Rita Boland, SIGNAL Magazine

Microsoft and Google are two of the most recognized company names in the world. And just as they revolutionized the past, these leaders are striving to invent the future. Microsoft changed the world of personal computing with its software, but even as it continues to improve its Windows offerings, Bill Gates' brainchild has moved into search engines, mobile platforms and the government arena. Not planning to be left behind, Google is making its own inroads into many of the same areas.

Lewis Shepherd, director of Microsoft's Institute for Advanced Technology in Governments, explains that industry is spending much more on research and development than the government. Microsoft plans to invest $9.5 billion this year. "So we have a distinct corporate interest in being around for another three decades," Shepherd says. "The only way we're going to do that is by creating great, compelling new capabilities, and we're inventing them in our labs." He also believes the government must pay attention to industry developments so the public sector understands the latest advancements, especially in light of shrinking budgets. The standing up of his group in 2004 represented Microsoft's desire to work closely with government to advance technology in the public sector.

Shepherd's company identifies five major areas of investment as particularly important for the future of the Internet and computing: cloud computing, semantic

computing, natural user interface (NUI), big data and quantum computing.

Some of the areas cover both current and upcoming technologies. "We've been in the cloud computing business for a long time," Shepherd says, referencing the cloud-based email system Hotmail that Microsoft acquired in 1997. Since then, he says, the corporation has developed an understanding of the planetary scale of cloud computing for people who want free email or chat services. With that type of hosting service, enterprises no longer have to invest large sums of money for their own premises, benefiting not only businesses but also making it attractive for the government, Shepherd says.

Semantic computing is becoming prevalent to savvy users of the Internet today as well, he states, although plenty of development and opportunity remain. Microsoft has made large investments in the technology, most noticeably through Bing. "We really do mean it when we describe it as a decision engine," Shepherd says, adding that increasingly powerful computation is built into the core Bing services. For example, the flight-comparison tool lists not only airlines and prices but also whether costs are likely to increase or decrease as well as the search engine's confidence in its own prediction. Other sites offer some similar features. Kayak.com, for example, charts fare trends over the past 90 days, and many travel sites can disclose less expensive travel dates.

"People want information relevant to a decision they're trying to make right now," Shepherd states. Bing's mapping tool can plot tweets, showing locations during events, for instance. "That's all driven by a semantic backbone," he says. Microsoft, Google and Yahoo! are working together on a semantic computing project called schema.org that offers shared vocabularies to webmasters so they can code their pages in ways that the major search engines will understand better.

Microsoft recently made progress in its third main area of investment—NUI—with the launch of Xbox Kinect. The gaming console has no handheld controls, instead using motion sensing, skeletal tracking and even voice and face recognition to determine what players want to do. Shepherd believes that Kinect is a toehold into the future of the interface.

He continues by saying that although the Internet is becoming more mobile, research shows that people will not want to interact with augmented reality and vast amounts of data describing the world around them via three-inch plastic chunks. Through the availability of items such as long-life sensors developed by the military and through the computation available in clouds, "the way you'll encounter computers will increasingly be through your real environment," Shepherd says. Lights will turn on with the wave of a hand; devices will recognize faces and gestures; and software will respond to speech as well as identify users and their preferences. "The computer works on your behalf instead of perpetually at your behest," Shepherd explains.

NUI may be becoming important in the world of computing, but it is not alone. "The world of big data—it is almost impossible to overstate its importance," Shepherd says. He uses Microsoft email services as an example: through the services users send billions of emails each day, and the company stores data on various aspects of them such as transmission rates and speed. "This is data at a planetary scale in real time ... it becomes a massive playground out of which you can derive fascinating and unanticipated information from all that data," Shepherd explains. "For national security that is absolutely critical and important." His knowledge is not confined to an outsider's view—Shepherd worked at the Defense Intelligence Agency in his life before Microsoft.

From the scientific computing perspective, big data is increasingly important in terms of analytic tools that can process the large-scale data at real time necessary for advancement. Microsoft has a major initiative to work with academic and scientific researchers worldwide to understand the data and tools they want to be able to use. Shepherd says the effort helps Microsoft better understand the minds and intents of users so the company can provide the best services.

Microsoft has worked with NASA and others to create the Be a Martian website that opens up the vast data stores from Mars to a large number of interested people instead of limiting it to a small group of government researchers who could never look through it all on their own. In addition to the profit to the scientific community, children who play and explore on the site benefit by receiving more scientific education. "We think big data is going to be a fun and profitable world for us," Shepherd says.

The company also is working with academics and scientists in its quantum computing investments. "If it pays off, it will lead to a fundamental revolution in computing," Shepherd says. "I know certain areas of government are very interested in following this, and we wind up helping them understand what our work and the work of others could potentially mean." Fields such as cryptography could benefit from it, for example, and it could change what people can do with computers, he adds.

What Microsoft is to software, Google is to the Internet. And Vinton G. Cerf, the company's chief Internet evangelist, has the future of the technology firmly in mind especially after participating in World IPv6 Day and talking to others about how to make the new protocol a reality for consumers. It enables the 128-bit Web address instead of the 32-bit space used in IPv4. The 128-bit address space format allows 340 trillion trillion trillion addresses to be established.

The new version is critical to the Internet for several reasons, including the fact that IPv4 basically has run out of addresses and that increasing numbers of devices are seeking access. "IPv6 simply allows the Internet to continue to expand and have more participants," Cerf says.

Unfortunately, the two versions are not compatible, so Internet service providers (ISPs) are working to find a way to allow subscribers to see pages in either format. Cerf explains that users should notice no difference if integration efforts are performed correctly. "In theory, no one should know," he states. But because subscriber equipment could be misconfigured, providers may have to reconfigure to work with both formats. Cerf says the idea is to let ISPs expand their range of services. The "Internet of things," which refers to all the items that run some type of Internet technology, would be unimaginable without the new version of Internet protocol (IP), he adds.

Another area of interest for Cerf is one attracting the attention of almost all computing specialists—the cloud. He says the concept is interesting because it creates a computing infrastructure that people can use without paying for it. Google offers free services while charging for advertising and applications. Speaking about Android, he explains that people can create new apps on the system without paying for the infrastructure, and they possibly can have a financial return. Google Apps offers a similar platform.

Cerf also highlights Google Earth over which people can build layers and then offer their third-party map app for compensation or for free. Google believes that it can afford to create such accessible infrastructures that others can monetize. Cerf says his company is not the only one making infrastructure available for free or low cost, and the participation of others in similar business models validates what Google tries to do, marking this as a real market sector. He adds that the plan is good for consumers.

Google's theory is that ubiquitous access to the cloud is important, and the company intends to encourage it. "If you can get to the cloud, you can get to our services ... we want you to be able to connect to our services," Cerf states.

The future of the Internet is in the application space, Cerf believes, where intercloud interaction standards are emerging, as are smart-grid systems and machine-learning capabilities. Artificial intelligence for tools such as language translation resources and smart cars is expanding as well. Cerf states that in the long run, intelligent transportation—which employs technologies to help make vehicles safer—may be the only way to keep humans secure as they continue to pursue dangerous driving habits. Actions involving electronics, such as texting or chatting on smartphones while at the wheel, are becoming common factors in accidents.

Google also is preparing for the future by branching into a new realm for them—that of network provider. In the past, the company's offerings rode on the services built by others. However, as companies stop creating super-high-speed fiber networks because of economic unfeasibility, Google has undertaken a project in Kansas City, Kansas, to build a network that offers the general public speeds of 1 gigabit per second. The company is interested in the economics of the project to help inform itself and others about the commercial viability of creating such networks.

Also on Google's radar is the recent economic downturn. Cerf says it could impact his company if advertisers decided not to buy on Google. However, because the company and the Internet are global, he believes downturns would have to occur in many sectors and jurisdictions before a real difference is felt.

What does cause concern for this Internet giant, as well as for the other companies and consumers doing business online, is security. "I think the most visible tension right now has to do with privacy," Cerf says. This extends to intellectual property and authenticating users. The debate on the issue has led to rigid practices including authorities blocking certain sites. In addition to individuals' worries over their information, the government is concerned with physical and digital fraud and theft.

For its internal employees and for servicing third-party accounts, Google uses a two-authentications system to ensure that the right people access information. Cerf references a device that can create a cryptographic six-digit identifier that can be used along with usernames and passwords to protect the Internet against bad logins and phishing accounts.

Beyond the civilian world, the pieces of the Internet future have direct relevance to the military. Cerf explains that cloud computing can extend capacity in a local theater campaign. However, the cloud is useful only if people can connect into it, and to sustain operations, the physical infrastructure will be "as important as anything," according to Cerf. Users have to think about building robust connectivity and the ability to recover from loss. He says he sees opportunities hiding in the design of the Internet for absorbing new technologies into systems to create a better fabric.

Google's cloud includes many replications, redundancies and capabilities for recovery. Cerf states that the company believes it has built resilient systems and that the military has a need for such resiliency, as well as a need to build connectivity in the field that accesses cloud-based services. Google also has implemented data liberation, meaning that if people put information into its system, they can retrieve it, which offers peace of mind for most consumers.