Cerf's Up Again
(Ubiquity Interview with Vint Cerf)

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[Vinton G. Cerf is Sr. Vice President of Technology Strategy, MCI. He was the first person interviewed by Ubiquity, five years ago.]

UBIQUITY: Congratulations again on your most recent ACM Turing award, with Bob Kahn as co-recipient. You are legends.

CERF: Thank you very much. Bob and I were quite surprised because it hasn't been offered to working people in the past. So, this is an unusual event.

UBIQUITY: Do you see him much?

CERF: Well, Bob and I both live in the D.C. area. We sort of cross paths infrequently during the course of the year, sometimes because there are conferences that we both go to. Sometimes it's accepting awards or attending other award events, like the National Medals of Science and Technology Gala that took place last week. So, we see each other a few times a year.

UBIQUITY: If the two of you had to explain to high school students what it was that you had invented, what would you say?

CERF: Well, that question's come up several times actually. We tried to explain that what we did was to devise a design and then the specifics of how to get a number of disparate package switch networks to intercommunicate in such a way that they looked like they were all one gigantic uniform system. And that's what we call the Internet today. Students usually have to be told what packet switching means, and sometimes we have to spend a minute or two to explain why that's different from the traditional telephone circuit switching. Most of the kids are familiar with the Internet, although they are not necessarily familiar with where it came from, and their knowledge of how it works is often viewed through the perspective of the World Wide Web, but of course the Web is only one application that's running on the Net. So, sometimes we have to work on distinguishing the Web from the basic underlying network from other applications that make use of it.

UBIQUITY: Do you have any way of explaining what you did in contrast with what Bob Kahn did?

CERF: Well, no, because the two of us worked very closely together. The original papers were written together in 1974. Bob was at DARPA at the time and I was at Stanford. But then two years later I joined Bob at DARPA and took responsibility for the overall interneting program, along with some of the other networking initiatives, including ARPANET. So, although by that time the ARPANET's operation had been transferred to the Defense Communications Agency, my involvement with that was related to security more than anything else. I was the program manager and eventually the principal scientist, and Bob was the office director, and during my six years at DARPA I was directly involved in managing the program and Bob was somewhat more indirectly involved. Then I left in '82 and he had to pick it up again until he could bring in Barry Leiner to run the program a year later. Still later we both helped to found the Internet Society, and we've both been involved in one way or another in supporting the IETF. During the years that I was at CNRI, for example, I ran the program that supported the Secretariat for the IETF. In fact, I initiated that program with a proposal to the National Science Foundation way back in 1988. So, our paths have intertwined pretty significantly. I

would say that in the last 10 years or so Bob's focus has tended to be more on the application space, on the handle system, intellectual property management, digital rights management, etc., whereas my focus has tended to be on either operational Internet engineering and policy (with my MCI hat on) or on ground rules for certain aspects of Internet use because of my chairmanship of ICANN.

UBIQUITY: And you're still chairman of ICANN, right?

CERF: I am indeed. I don't know how long this penal servitude is going to go on. I was re-elected to serve as chair last November. I am pretty sure that my term will probably be over in November of this year, which is when we have our annual meeting, because I will have served for something like six years on the board and five years as chairman. And that's long enough, I think, for anybody. After that, I think we need some new people to take that responsibility. So, my guess is that my term as chairman will complete at the end of this year.

UBIQUITY: Let's start this interview by updating one of the most important topics in our conversation five years ago: what's new with your wife and your two boys?

CERF: Well, one son is living in San Francisco and one in Hollywood. The son in Hollywood is a cameraman, and he finds himself traveling around internationally doing various documentaries and television programs and commercials. The son up in the San Francisco area works for Apple and is responsible for the documentation for what's called Final Cut Pro, which is a very elaborate digital video and audio editing system. He's just completed a complete revision of the documentation. Two thousand pages worth of material in four volumes: a huge piece of work. I think he's planning to take two months off to recover, but he's done very well because the original documents were about 700 pages long. He's actually tripled the size of the material available to users.

UBIQUITY: And their parents?

CERF: Sigrid and I moved into a new house about two-and-a-half years ago. One of our most important upgrades was to install a wine cellar, which we completed last summer, and which we're now in the process of filling up. It has a 3,000-bottle capacity, and we certainly don't have that many bottles. We have about two-thirds of that. And you kind of want to leave some room to make it easy to bring a case or three in at will. And then you start calculating how long will it be before you can drink this wine and how old will you be at that point and how much more wine can you really buy before you can't buy anymore that you could drink. So, we're noticing that bottles that we bought in the mid 1990s are already 10 years old and we haven't consumed them yet. We're thinking maybe we should have bigger parties.

UBIQUITY: This sounds like a good operations research project for somebody.

CERF: Optimization, right.

UBIQUITY: And Sigrid's cochlear implant is still working well?

CERF: The cochlear implant is working wonderfully well, and continues to serve her in almost every dimension. She also continues to make heavy use of other assistive gear. So, for lecture halls she has FM transmitters and receivers, and she has a variety of wired microphones that she can use at the dinner table or other noisy restaurant settings. She uses patch cords to listen to Sony Walkman music or listen to books on tape or books on CD. She's listened to some 500 books now on CD, which is amazing. She watches television and uses an infrared transceiver to pick up the audio that goes

straight into her speech processor. Similarly with movies. And because many movie houses now are transmitting an audio tract over an infrared signal, what she gets is pure audio straight into the speech processor as opposed to acoustically produced stuff. So, she actually hears better than most of the rest of the people in the audience. She can do the same thing onboard aircraft using a patch cord going into the armrest.

UBIQUITY: How did she describe the feeling of going from complete deafness to being able to hear so well?

CERF: Well, I think the most common phrase for many months after this implant was done in 1996 was, "I heard that!" We actually thought that if we do a biography of Sigrid, which I think we should do, we should title it, "I Heard That!"

UBIQUITY: It's a great title.

CERF: She used to report every bird that she heard as we would take the dog for a walk. Now she complains that the dog is whining too much and bothering her, and sometimes she turns her speech processor off for some peace and quiet. So, you get very quickly accustomed to hearing lots and lots of sound. Sometimes you enjoy being able to turn it off.

UBIQUITY: That's a wonderful story. Another thing we talked about in our interview five years ago was the importance and value of risk taking. Have you risked anything in the last five years?

CERF: Well, it's interesting that the last five years have been remarkably up-and-down for me personally and for the company I'm still associated with. As you know, MCI was acquired in 1998 by WorldCom. It's probably the worst possible thing that could have happened to it given the derelict way in which the CFO and the CEO managed the company and the failure of the board to detect the abuses that were taking place. So, of course, MCI went -- WorldCom went -- bankrupt. It wiped a lot of people out in terms of personal retirement and other assets. Some $200 billion or so of value was wiped away as a result of that bankruptcy, and of course I'm among the victims. So, that was unpleasant. Digging your way out of bankruptcy was no fun. And more recently, of course, we've been in the middle of an acquisition battle between Qwest and Verizon, fighting over who's going to buy MCI. Personally I wish that we could have a year when we aren't either being bought or being -- or buying somebody or going bankrupt or coming out of bankruptcy. How about a just nice, plain year where we just grow revenue and work on new products and services?

UBIQUITY: And is that in the cards?

CERF: Apparently it isn't to be, at least through this year. And so from 1998 till the present it has been a raucous rollercoaster, many suitors, ranging from British Telecom, who got cold feet, to GTE to WorldCom and then Verizon and Qwest.

UBIQUITY: Do you have any general thoughts or theories about what kinds of mergers make sense and what kind don't?

CERF: I would be pretending to be more of a businessperson than I feel I am if I were to try to say anything definitive. But you have to look at these things and ask yourself what does it do from the business point of view. What does it do from the point of view of the investor? We have a rather peculiar situation right now because most of the holders of MCI stock were actually acquirers of debt at a fraction of the dollar. These are speculators who really don't care about the long-term prospects

for the company. They would only care about what's the immediate value to be gained in a merger bid, which is why you've heard so much debate back and forth between the Verizon and the Qwest offers, because the Qwest offer has a kind of a quick-hit characteristic to it, whereas it doesn't offer as good a long-term match -- it's just another carrier with a lot of fiber in the ground, and we don't need more of that. On the other hand, the Verizon deal gives bulk to the operation. It's a $100 billion company and we'd be somewhat bigger on acquiring MCI. It has a lot of local capability that would match well with our national and global capability. So it's a better fit from the business point of view.

UBIQUITY: What's likely to happen?

CERF: Still unclear. The problem, of course, is that the argument about which shareholders should be most benefited ranges between the people who are interested in short-term gain and the people who are interested in longer-term stability. There is a regular argument that's made that you have to get bigger in order to compete in a global market. And although I suspect that there is a certain truth to that (because you need bulk in order to be able to make significant investments), I am not as persuaded that being big for the sake of being big is necessarily good. To the contrary, it could make you less agile, and make it harder for you to make decisions, and harder to grow revenue in a way that's attractive to the stock market. So, if you're looking at long-term investor value, the harder it is to grow revenue the less attractive your stock is and, therefore, the less well-treated you are on Wall Street. Just getting big doesn't necessarily produce effective growth in the business. But, again, I need to warn you that I'm just an engineer and I'm not a business guy. And so, I'm not sure that any of my business analysis is worth much.

UBIQUITY: What are your thoughts as you consider the future of the telephone industry?

CERF: It's very clear the two enormous forces are at work right now. One of them is mobile telephony. And there's no question at all that it is having an enormous impact everywhere, particularly in places where there were no telephone services or very few and very tardy in their delivery. The other place where it's having a big effect is in the wire line world, where people are abandoning wire lines, certainly abandoning second telephone lines, in favor of mobile and high-speed access to Internet, whether that's DSL or cable modems or perhaps broadband over power lines or maybe even laptop radio. So, Internet and mobile telephony are both having a huge effect on both the technology and the business models of the traditional telecom market. There's also a very clear convergence taking place. And as more and more of the mobile phones become Internet-enabled, eventually they will be sufficiently Internet-capable that the traditional telephone call will evaporate and be replaced by applications that make use of Voice-over-IP. And it's important to distinguish between traditional telephony and Voice-over-IP in that the VoIP capability is just another thing you do on the Net: it can be a simple adjunct to something else. For example, it might be collaborative game playing. It might be collaborative meeting software, or it might be embedded along with, for example, the WebX service so that you can speak to each other through the same channel as you're looking at Web pages or at PowerPoint slides. It's just another thing that you do by turning the microphone on, so to speak, as opposed to going to the trouble of placing a phone call or setting up a conference call.

UBIQUITY: What's your larger point?

CERF: People tend to map it into traditional telephony, and I resist that on the grounds that it isn't traditional telephony at all. What it really is is an example of either bilateral or multilateral interactions on the Internet, or at least that's what it is moving towards. So we now see a convergence of the mobile world and the broadband Internet world, as well as the wired Internet world and the wireless Internet world (which are now merging in the form of 802.11 and soon 802.15 and 802.16). And as we

see all these various broadband functionalities converging on IP we will also see a convergence of the traditional application that's embedded in that environment. Video-over-IP, voice-over-IP, radio and sound over IP, all of these things will become part of a common Internet environment and subject to software control. So the most powerful thing here that's happening is not that you can carry sound over the Internet in packetized form -- that's no big deal. What's interesting is that the control of all that is under the control of software that's running typically at the edges of the Net in the intelligent instruments that you're using. Those devices can cause a number of actions to take place.

UBIQUITY: Examples?

CERF: For example, they can involve other devices than themselves. So, you can have conference call set ups happening from somebody's PDA. The PDA may not itself be part of the conference call, but other devices will be. Mobile phones get rung or your VoIP software on your laptop suddenly alerts you that there's a conference call in progress, or you move smoothly from talking to each other -- from typing to each other in the Instant Messaging world to talking to each other to looking at each other. In fact the notion of presence, which has arisen out of Instant Messaging, is now becoming a very refined concept, and it will probably be what we could call the twenty-first century dial tone.

UBIQUITY: Explain the notion of presence for us.

CERF: The notion of presence simply says, "Hi. I am available in the following media to the following people." And, of course, depending on who the people are you may have different willingness to be available in different modalities. Some people you accept phone calls from. Others you'll send off to voicemail or to universal e-mail. Some calls may go over to you on your pager and you're able to decide what you want to do with it, and so on. This idea of presence is becoming very powerful indeed, and it's embedded in the software at the edges of the Net. Anyway, those are all changes that are happening to the technology of communication. And those changes are having a pretty dramatic effect on the economics of the telecommunications world.

UBIQUITY: What about your own interaction? What is the day in the technology life of Vint Cerf? Do you have a BlackBerry, for example?

CERF: I do. I have a BlackBerry. My BlackBerry is really a BlueBerry: it's actually a mobile phone plus short messaging plus e-mail. I carry an extra mobile phone and a pager. I'm always with my laptop. I'm very rarely not with my laptop. And it is as often as possible plugged into broadband Internet services. When I'm sitting in a hotel room I use a broadband Internet service; when I'm at home I use an 802.11 Wi-Fi access point in the house. I'm on e-mail regularly and I carry out an awful lot of my interactions with other colleagues using Instant Messaging when that's convenient. And, of course, today, for example, I've been on four conference calls, and at least two of them have involved WebX type interactions where you're using a collaborative tool to share spreadsheets and Web pages and things like that or PowerPoint. I have built into the laptop a VoIP capability, so I can reach you that way in addition to using ordinary telephony. And that's always convenient because you're using a single instrument to interact in a variety of different ways.

UBIQUITY: You suggested a little bit earlier that underdeveloped countries could do some technology leapfrogging using things like mobile communications.

CERF: Well, certainly that has happened in the sense that the mobile telephony has allowed the provision of communication services, and let me include in that Internet access, in places where it was very difficult to obtain that service before. And so, I think roughly the number of telephone

terminations has more than doubled in the last five years. It's gone from a little over a billion to a little over 2.3 billion. And the 1.3 billion of the 2.3 billion are mobile telephones. So, it has had a tidal wave effect on access to both mobile telephony and also the many instances in the GSM system anyway of short messaging. It's extremely popular. And these devices are becoming increasingly Internet-capable. So, you're seeing people use these things for navigation. They use them for some certain amount of Web surfing, for identifying products and services that they're interested in. These devices are becoming much more elaborate than they were ever before. They have a lot of horsepower, a lot of compute power, a lot of memory. Some of the displays are getting bigger. So, it's very much a universal tool. I'm even seeing financial transactions being done through these mobile telephones. And this of course adds a certain degree of convenience. You don't need a credit card anymore. It's your mobile phone that is making the payments.

UBIQUITY: So you don't think it's too fanciful to think that leapfrogging would continue to work and that the kind of rich environment that you were talking about just a minute ago could be realistically obtained by countries that are now underdeveloped?

CERF: I want to be a little careful about the leapfrog argument because mobile telephony doesn't have the same potential capacity that the wire line does, especially optical fiber or coaxial cable. And so I think that many countries that are experiencing this huge influx of traditional mobile telephony, if I can call it that, may still be constrained as to the applications they can support over the air. So they have to find a way to mature wire line capability concurrently with the mobile, at least that's my view. It's possible that some of the broadband wireless capabilities can be used as a substitute. Ultra wideband radio, for example, and maybe WiMax would be alternatives to wire line, but I think we should be very cautious about predicting massive leapfrogging merely as a consequence of mobile telephony deployment. I think it's also very important in economic terms to recognize that the use of these technologies for economic gain require a certain amount of infrastructure to be in place, not only physical infrastructure but trained people who can operate various pieces of equipment and know how to configure things and the like. And so, at the same time there's investment in physical facilities there has to be a serious investment in training so as to create a local population that's able to operate with these increasingly complex systems.

UBIQUITY: Your reference to populations of users prompts me to note that some people who've been around awhile are nostalgic for the early days of the Internet when there was a certain non-commercial purity to everything. Do you share any of that nostalgia?

CERF: That's an interesting question. In some sense, yes, I suppose you could say that it was a lot nicer when we were a more homogeneous community and all we cared about was research. On the other hand, I was a very strong supporter of commercializing the Internet system, as far back as 1988, because in the absence of doing that it wouldn't spread very far, and I felt strongly that it was important for Internet to be more widely accessible. For that to happen it had to be self-supporting, and that meant commercially supportable.

UBIQUITY: And how has it panned out?

CERF: In a way it's a tougher challenge now. There are more people out there who choose to abuse the network. It's not surprising because if you hold up a mirror to the Internet you see a reflection of the general population. And we know that in the general population there are people out there who don't mean everybody well. So we are challenged to deal with abuses on the Net, in the same way we've had to deal with abuses in other media. And I think because the Internet is an international global medium and so readily accessible, it may make it a little harder to cope with some of the

abuses, such as spam, pornography, fraud and so on, all of which are abuses that could take place in other media, and often do. And we've had to come around to finding ways to combat that. We may need international cooperation to deal with some of the problems, such as spam. It's a pity that we have to deal with all this, but then it's the side effect of being mainstream. Now people are abusing their ability to break into operating systems to create zombie armies of machines that will do denial of service attacks or other kinds of mischief. And in some cases it's possible that people are deliberately hacking at the Net for gain, being paid to do this for industrial espionage or interruption of competitor services and things like that, all of which the ISPs in some respects have to cope with.

UBIQUITY: Which again brings up the subject of Internet governance, and you are the chairman of ICANN.

CERF: Yes, it does. It's a very broad topic, although there are parties who would like to narrow the topic down to what ICANN does. And I'm sorry that I don't agree with that particular view. What ICANN does is very important, of course, because it deals with a very core component of the network, the domain name system and the IP address allocation and also the parameters that are associated with the various Internet protocols. But I see governance as an extremely broad subject, having to do with all of the concerns about abuse and fraud and other misbehavior on the network, which in some cases requires law enforcement engagement and in some cases it needs the involvement of international organizations like the World Trade Organization or the World Intellectual Property Organization. So, it's an extremely broad topic and one which needs to be addressed internationally as well as domestically. So, I'm of the opinion, generally speaking, that governance should not be limited to just those things that ICANN does, although I think ICANN has a pretty good formula for dealing with the many constituencies that are interested in the things that ICANN is responsible for. But I would like to see the other international organizations, particularly the World Trade Organization and WIPO, step up to the plate to deal with some of these problems that are well outside the purview of ICANN and are also outside the purview of any national agency and therefore require international cooperation.

UBIQUITY: On that international note, why don't we close the interview by asking you to tell us where things stand with the Interplanetary Internet?

CERF: I'd be delighted. The work at Jet Propulsion Laboratory started in 1998 in the spring. It has continued to evolve pretty significantly since that time. We have been through the little core engineering team at JPL, has been through now four iterations of the design of the protocols that are required for interplanetary extension of the Internet. Since the time that we started, however, we've discovered two other important R&D areas that we're pursuing very vigorously. One of them is to note the utility of these protocols that were originally designed for interplanetary work in the setting of sensor networks and general radio communications environments. We call this delay- and disruption-tolerant networking, the observation being that in mobile environments and in radio-based environments you often wind up with a variety of impairments related to interference, or sometimes there's radio shadow and things like that, where you cannot communicate reliably until you've moved into a different position. As a result, simple protocols like TCP don't work very effectively because they have trouble distinguishing packet loss from congestion, and they back off inappropriately in some of those circumstances. The other area, which is related, that's of interest is in tactical military communications, which again require radio immobility. We have engaged with the Defense Advanced Research Projects Agency a second time now in connection with this project.

UBIQUITY: The second time? What was the first time?

CERF: The first time was to fund the basic architecture of the interplanetary design. The second funding effort, which was just announced the beginning of March, is to develop delay- and disruption-tolerant networking for military tactical communication. We hope that this will contribute to the military's continuing use of Internet in its application. In particular, we've been concerned that the Defense Department may be so heavily dependent on the traditional TCP/IP that they may miss an important opportunity to build a more robust system for tactical mobile communication. For people who are excited about the mobile communications world in the civilian sector, we believe these same protocols will become quite useful for applications in which mobility in a disrupted environment may be important. So, we're quite excited about where we've come in the last six years, going on seven years, in that project. And we're excited by the prospect of being able to put some of the interplanetary system in place as early as 2009 with a Mars telecom orbiter going up at that point, which we hope will become an important interplanetary relay.

UBIQUITY: That sounds terrific. Again, congratulations on the ACM Turing Award recently awarded to you and Bob Kahn.

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