VINTON CERF, TCP/IP,

and

AN UNDERLYING FAITH IN TECHNOLOGY

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TITLE MISSING

SHOULD START AT p #1

I. INTRODUCTION

Man tends to believe that anything he does cannot fail. This is especially true with regards to technology. Vinton Cerf is one example. His development of the TCP/IP protocol, his continued work with the Internet and his influence on the Internet's development show an underlying excessive faith in technology and its integration in our lives to unify the world. The development of the TCP/IP protocol has also bolstered the faith of others in the abilities of technological integration to unify the world.

It would be good to define what you mean by "excessive."

II. DEVELOPMENT OF TCP/IP

Vinton Cerf got his first look at a computer when he was fifteen. The computer filled three rooms with vacuum tubes. Two years later, with permission from the University of California, Los Angeles (UCLA), he and a friend were programming a Bendix G-15 papertape computer. According to Cerf, "The bug had bit, and I was infected with computers." [1, p. 132]. Cerf graduated from Stanford University in 1965 and went to work for International Business Machines (IBM) as a systems engineer. He then returned to school at UCLA to pursue his Ph.D. in the computer science department. While he was there, the Advanced Research Projects Agency (ARPA) started a program at UCLA in expectation of building the ARPANET [2] . During the next few years, the development of the ARPANET became a large part of Cerf's work.

Four schools were to be the first nodes on the ARPANET: UCLA, Stanford University, the University of Utah, and the University of California, Santa Barbara. In 1968, Cerf joined a group of students from these schools to discuss the network and its potential problems. This group was titled the Network Working Group (NWG). The NWG became very important in aiding the development of the ARPANET, but no one realized it at the time. As Cerf puts it, "We were just rank amateurs, and we were expecting that some authority would finally come along and say, 'Here's how we are going to do it.' And nobody ever came along." [2].

The NWG was particularly important in the development of a protocol that would allow the computers to communicate with each other. The protocol they came up with was the Network Control Protocol (NCP). They also developed Telnet, which allowed remote logins, and other protocols to run on top of NCP [2].

While the NWG was working on its protocol, other networks were being assembled in other parts of the country. One example was the ALOHAnet, located in Hawaii, which was a network of radio links [3, p. 69]. However, each of these networks was independent and used its own protocols for computer communication. Cerf remembers the issues that a colleague, Bob Kahn, brought up, "Look, my problem is how I get a computer that's on a satellite and a computer on a radio net and a computer on ARPANET to communicate uniformly with each other without realizing what's going on in between?" [2]. Cerf and Kahn decided to do something about this frustration. They wanted to come up with a protocol that could connect each different kind of network into a larger, international network.

In 1974, Cerf and Kahn published "A Protocol for Packet Network Intercommunication." This paper described the kind of protocol they were envisioning. This protocol required gateways between the connected networks that would translate the data from one network into a form the other network could understand. The data to be transmitted between the networks would be broken up into pieces called packets. These packets had an internetwork format that contained the source of the packet, the destination of the packet, the sequence number of the packet, the byte count, a flag field, text for delivery, and a checksum. The source and destination gave information about where the packet originated and where it was headed. The sequence number and byte count were used to properly order the packets at the destination and detect fault conditions. The flag field was used for other specific control information. The text was the actual data being sent and the checksum was used to verify the data at the destination. The protocol also permitted each network to add information to each packet to allow it to pass through the network. This information was added in a local header added to the beginning of the packet [4, pp. 638-639].

Cerf and Kahn went on to explain their idea that a host computer would have a transmission control program (TCP) that would manage the transmission and reception of data for computer processes. The TCP would be responsible for delivering received data to the correct processes, and sending data from processes on the host computer to processes on other computers. In order to deliver data to the correct process, Cerf and Kahn proposed that a process header be added to the packet that would identify the destination process. In addition, the TCP would be responsible for splitting the data into segments for transmission and splicing back together received segments [4, pp. 640-641].

Because there was potential for each gateway to split each segment into smaller packets, the flag field on each packet was used to determine whether or not a whole segment or message had been received. As soon as a flag was set to indicate a whole segment had been received, the TCP would put that segment's pieces together with other segments until another flag was set to indicate the whole message had been received. At that point, the TCP would pass the message on to the appropriate process [4, p. 642].

The problem of faulty transmission was also discussed. A TCP would transmit a certain number of packets and wait for acknowledgment that all were received. If it did not receive acknowledgment within a certain time, it would retransmit the same packets until an acknowledgment was received. If duplicate packets were received, the receiving TCP would be able to detect the duplicate sequence numbers [4, p. 643].

In 1977, TCP was implemented successfully. It was tested by starting a message in San Francisco from a mobile unit, transmitting it via radio link to an ARPANET site, over the Atlantic Ocean via satellite link to Norway, through ground and radio networks to London, back across the ocean via satellite to ARPANET, and finally receiving it intact at the University of Southern California's Information Sciences Institute in Marina del Rey [3, p. 90].

A year later, TCP was enhanced and broken up into two parts. The Internet Protocol (IP) became the manager for ensuring packets went to the correct locations, and the Transmission Control Protocol (TCP) became the manager for putting together the packets, retransmitting them, reconstructing them, and error checking. TCP/IP was born [3, p. 91]. In 1983, ARPANET adopted TCP/IP officially, and it eventually became a standard for internetwork communication [3, p. 109].

III. CERF'S FAITH IN TECHNOLOGY

After Cerf's involvement in the development of TCP/IP, he joined MCI in 1982 to perfect MCI Mail, an early e-mail system. He left in 1986 to do research on Internet technologies with Bob Kahn, his partner in developing TCP/IP. In 1992, he founded the Internet Society, a home for Internet policy and administration [1, p.132]. More recently, Cerf has teamed with NASA to work on developing an Interplanetary Internet. Clearly, Cerf has not given up TCP/IP and the Internet's development to others. He has continued to work with the Internet and influence its direction.

Cerf's interest with NASA for an Interplanetary Internet attempts to solve a unique problem. Unlike network connections here on Earth, communication links between probes, spacecraft, stations on Earth, and potential stations on other planets can be unavailable for long periods of time. In addition, due to the distance between them, the delay of the data transmission begins to play a significant part in deciding how to relay information. The plan is to come up with the protocols and the architecture to form an InterPlaNet (IPN). The IPN will allow space stations, probes, and other spacecraft to connect to each other and to the Internet on Earth as a "network of disconnected networks." [5].

In a recent essay, "On the Evolution of Internet Technologies," Cerf describes some technology changes fueling changes in the Internet. One example is voice over IP (VOIP), which seeks to provide an alternative to the common telephone. VOIP uses the Internet instead of dedicated telephone lines to transfer the audio data of a conversation. This, says Cerf, is just one example of the multipurpose Internet. The Internet is capable of providing much more, such as video conferencing and video streaming, as can already be seen in some instant messaging programs [6, p. 1363].

Another technology trend that will fuel changes in the Internet, according to Cerf, is the increased use of wireless and mobile devices. As this trend increases, the need for wireless access to the Internet will increase. Cell phones are a part of this trend, as they are increasingly incorporating other features that used to be reserved for desktop and laptop computers [6, p. 1362].

A specific form of wireless technology, called Bluetooth, enables devices that are physically near each other to communicate without wires. This has led to Bluetooth-enabled cell phones that are able to import phone numbers from a computer wirelessly and printers that can wirelessly connect to a computer. Bluetooth and other wireless technology could lead to another future Cerf sees for technology: computers that are aware of their surroundings. He sees this as possibly leading to a more beneficial partnership with technology. These kind of computers would be able to reconfigure themselves depending on the location or the user [7]. In addition, it could advance what Cerf considers the most important of the future services: using the Internet as a control system for our houses and other belongings [8].

Using the Internet as a control system implies that integrating technology into every part of our lives can help unify and bring the world together. Under that belief is an excessive faith in technology. Clearly, Cerf must have some faith in technology, or he would not strive to increase its uses. While this does not necessitate an excessive faith in technology, the author would argue that if he did not have that excessive faith, he would simply work to refine current technology, rather than try to increase its uses to connect the whole world.

With the development of the ARPANET and the ability to connect different networks, information could be easily shared among a number of different people, bringing one aspect of their lives together. Cerf aided this process, showing that he shared in that vision. He continues to encourage development, suggesting that he believes that using the full potential of the Internet can help bring us together in our forms of communication, such as video conferencing for the masses.

While speculating about computers becoming part of our surroundings in the future, he described several scenarios for their uses. One is a smart car that would open or not open a car door based on fingerprints. Cerf also recognized potential for this kind of technology to be used for evil, but in a statement declaring his faith in technology said, "I suppose there are darker scenarios but I am an optimist at heart and a true believer in technology." [7]. His desire to increase technology's presence, to connect the world through the Internet, and his bold statement of being a believer in technology all suggest an underlying faith in technology and belief that it can help unify the world by integrating it into every part of our lives.

IV. OTHERS' FAITH IN TECHNOLOGY

Since the beginning of the Internet, people have been wanting to use it to connect the world. In 1963, J.C.R. Licklider sent a memo to six schools that he had dubbed the "Intergalactic Computer Network" giving an idea for an "interactive network linking people together via computer." [3, p. 48]. His goal was to tear down geographical barriers and save humanity through technological progress [3, p. 49].

Today, people still see the Internet as a way to unite the world. The managing director of online directory Scoot, Jon Molyneux, has said about the future, "The world will be permanently online and the human race will begin evolving as a collective intelligence." [9, p. 21]. Sergey Brin, one of the founders of the search engine Google has said, "We'll use the Internet in the same way we use air now—we'll be breathing it. Everyone will have an RJ-45 jack [the type of connector used to connect to networks via Ethernet] in the back of their heads." [9, p. 21].

Donna Haraway, in a 1994 essay entitled, "A Cyborg Manifesto" said that the natural body is a thing of the past. Instead, she said that our bodies are linked to technology and we should embrace the blurring of difference between machine and organism. She herself would "...rather be a cyborg than a goddess." [3, p. 119]. She claimed that the combination of machine and organism offered opportunities to redevelop social relations and identities [3, p. 119].

Philip Emeagwali, who startled the supercomputing world in 1989 by using the Internet to perform 3.1 billion calculations per second, holds a similar view [3, p. 138]. He sees grid computing as the primary driving force behind the next generation of the Internet. Grid computing is a form of distributed computing that uses many computers to process data and instructions. As this change in the Internet occurs, the supercomputer and the Internet will converge into one entity. We will begin to compute without computers in our homes or in our offices, since the computer will be located throughout the world. This will lead to unique forms of human interaction and communication. We will be able to use tele-immersion, where someone in Europe will have the illusion of being in the same room as someone in Australia [10].

This line of thought continues with bionic brain implants with which we communicate by thought power. We will be able to communicate by telepathic mail (t-mail) instead of e-mail. These bionic implants could disappear into the Internet, much as the computer and Internet came together. This would lead to our minds and thoughts potentially disappearing into the Internet. At this point, Emeagwali says, "Thus the Internet could unify the thoughts of all humanity. Unification implies that we will become one people with one voice, one will, one soul, and one culture." [10].

Probably the most widely held view about the future of computing and technology is the idea of ambient technology. This is what Cerf was imagining, a computer that knows its surroundings. Ambient technology goes further and consists of devices that adapt, respond, and are sensitive to people in the area. This technology consists of three features, which Emile Aarts, Rick Harwig, and Martin Schuurmans describe as "ubiquity, transparency, and intelligence." [11, p. 239]. Ubiquity is the idea that we would be surrounded by a vast number of embedded systems, all interconnected. Transparency indicates that these systems would be moved into the background of our environment, and be effectively invisible. These systems would exhibit a form of intelligence by being able to socially interact with humans in one form or other [11, p. 239].

→ than what?

This kind of technology could exhibit itself in the forms of "intelligent" rooms that would sense your presence, change the temperature and environment appropriately, and be able to respond to verbal commands. It could also allow us to enter and exit a locked building by voice commands, rather than using keys. Dashboard computers in our cars could alert us of accidents and good parking spots. Our offices could be wherever we were, and we could stay in touch via holograms [12, p. 155].

Ambient technology has a companion that Bruce Sterling has dubbed "ubicomp." [13, p. 253]. Ubicomp would use embedded systems and sensors to keep track of an item's identity, its location, and its condition, constantly and permanently. This leads to such scenarios as a fork being able to tell us that it is a fork, that it is in the dining room, and that it is in good condition. If someone stole the fork, you could ask it where it was, and it would be able to tell you. This kind of technology would allow us to leave something anywhere we wanted, but still be able to find it later [13, p. 252].

However, for each of these ideas to work, they need one thing. They need a way for devices to communicate to each other and transfer information. This is where the development of TCP/IP fits in. It provides a way for those devices to communicate with each other in a consistent and standard manner. Since some different devices from different vendors are able to communicate with each other, people have started to believe that we can connect anything and everything. From this, they also believe that we must incorporate technology into every part of our lives. Each new device can communicate with any other device so, according to these predictions, that must be a good thing and must help us get things done and increase our human potential.

According to these believers in technology, adding this technology and interconnecting all of this technology will bring us all together. Our ability to share information implies that we will become a unified people and be able to break down the barriers between us. According to them, it could even bring us together in such a way that we will become one people, with a common goal and end.

V. CRITIQUE

weak

However, in ~~brief~~ critique, ~~the author would argue that~~ just because we are able to share

this type of phrase weakens your sentence. Just present your critique (we know it's you!)

all kinds of information, just because we can communicate with more of our senses with others across the globe without physically being there does not make us more unified as a people. This only brings us together as a people if we all believe that heading in this direction is the right choice. If not everyone believes that we should have all of these interconnected devices and communication, or if not everyone believes in the abilities of technology, we are no more unified than we are today.

Also, these believers in technology are ~~hinging~~ depending on very little failure in the implementation of their ideas. They may make some allowances for part failure and interruptions in networks, but if we were not able to supply power to these devices anymore, their ideas would fail. They provide no guarantee that these devices will never fail. Following their ideas, we cannot be a proper community of people if we do not have all of our ideas and information shared. We cannot be human if we do not have these devices to help us communicate to others. ~~The author would argue that we~~ We can still be a proper community of people without all of these devices and without interconnecting everything we do. We can be such a community if we are following Jesus Christ, doing his will, and following his principles. Also, we have confidence that He will continue to sustain the world we live in and allow our advances in technology to continue to work.

You and I believe this, but how would you convince someone?

VI. CONCLUSION

Vinton Cerf's development of the TCP/IP protocol, his continued work with the Internet and his influence on the Internet's development show an underlying excessive faith in technology and its integration in our lives to unify the world. This is made clear when he tends to disregard the possible negative scenarios of technological integration. By providing a protocol that allows different devices to communicate to each other, Cerf has also given others a vision for integrating technology into every part of our lives to result in a unification of the world. They believe that because we can connect some devices, we will be able to connect everything and unify the world in that manner. However, they fail to recognize that just connecting the world will not unify the world, and that the reason that our technology works as well as it does is because God continues to sustain His creation in such a way that it does not completely fall apart.

GRADING

COMPLETNESS A

STYLE A

ACCURACY A

REPORT GRADE A

A VERY GOOD PAPER!

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