

## **The Exclusivity of Ultrafast Communication Networks**

**dr. ir. B.H.M. Custers**

Research Fellow

Tilburg Institute for Law, Technology and Society (TILT), Tilburg University,  
Warandelaan 2, PO Box 90153, 5000 LE Tilburg, Netherlands

Senior Consultant

Capgemini Consulting Services, Capgemini Netherlands BV,  
Papendorpseweg 100, PO Box 2575, 3500 GN Utrecht, Netherlands  
B.H.M.Custers@uvt.nl

**Abstract.** Efforts are being made to develop a new generation of communication networks, based on ultrafast optical communication. This is likely to result in a significant increase in the speed and volume of information transfer on communication networks such as the Internet. However, the introduction of these new types of networks also requires more from its users. Because these new networks are more sophisticated, there are likely to be more costs involved and users have to be more knowledgeable about the new technologies in order to be able to use them. Such requirements in both costs and knowledge may prevent groups of people from access to the networks. If larger groups of people are excluded from the networks, social polarization may result. Another effect of exclusive networks may be the limited number of providers of structure and content, which might lead to manipulation of the information provided. In this contribution, the effects of exclusive ultrafast communication networks are discussed and some suggestions are made on how to deal with this.

**Keywords:** Internet, ethics, ultrafast communication, networks, social polarization, manipulation of information.

### **1. Introduction**

In the last decades, it has become clear that people are not only increasingly using information and communication technologies, but are also becoming increasingly dependent on them. As a result, numerous actions that people used to do in person or on paper are now performed digitally. For instance, many people are no longer booking their flight tickets through a travel agency in town, but use the Internet. In many countries, people request their tax returns via their home computers, no longer using paper files. Instead of going to a shop to buy a CD, many people nowadays download their music from the Internet.

Many companies and government organizations are using the increasing possibilities of offering their services digitally. The main reasons for this are the ability to use a more targeted approach and to reduce costs. The targeted approach is simply to adapt to the clients or users, who may find it easier to book a flight ticket at home at their computer than to go out, find an office and be dependent on opening hours. Hence, a travel agency may rapidly lose market share and profit if it does not have an online office for bookings. Regarding the costs, it may also be much less expensive to offer products and services on the Internet than keeping a shop in a shopping street or mall where rental costs are high and personnel is expensive.

At first glance, there is nothing wrong with offering more customized and cheaper services via the Internet. However, there may be a considerable drawback for people who do not have access to the Internet. Because digital services may address most customers and may involve fewer costs, it may ultimately no longer be profitable for companies to have offices in town where people can go to for their products or services. As a result of Internet trade, many music stores, travel agencies and bank offices have already downsized or closed. It is expected that many more will follow in the years to come. People who do not have access to services offered digitally are increasingly experiencing difficulties obtaining the services and products they require. Most people who are not connected to the Internet do not have a subscription for financial reasons. Particularly those shops in town that remain focus on the high end of the market, with very personalized and tailor-made services. In short, the communication networks are gaining in exclusivity, increasing the gap between those who are connected (the haves) and those who are not (the have-nots). In this contribution, it will be investigated how ultrafast communication will influence this exclusivity of the communication networks.

In Section 2, we will discuss briefly the technological developments regarding ultrafast communication networks. In Section 3, the term exclusivity will be discussed in more detail. The main reasons for exclusivity, costs and knowledge will be investigated in Section 4. Exclusivity may result in social polarization and in manipulation of the information when there are only a limited number of providers of structure and content. This is dealt with in Section 5, while Section 6 offers conclusions and some suggestions on how to deal with these effects.

## **2. Ultrafast Communication Networks**

Technological change is exponential. According to Moore's Law, the number of transistors on an integrated circuit (a 'chip' or 'microchip') for minimum component costs doubles every 24 months (Schaller, 1997). This more or less implies that storage capacity doubles every two years or that data storage costs are reduced by fifty percent every two years. This empirical observation by Gordon Moore was made in 1965; by now, this doubling speed is approximately 18 months. Moore's Law deals with storage capacities, but similar observations are made for communication speed and volume. According to Gilder's Law, the total bandwidth availability of US communication systems has tripled every twelve months since the 1980s and will expand at the same rate for the next 30 years to come (Raessens, 2001).

Moore's Law is not only about making existing technologies more efficient. It also takes into account the new ideas and inventions in the field of information technology. The latest developments to increase the speed and volume of information transfer on communication networks are focused on changing from electronic communication to optical communication. This is likely to result in a significant increase in the speed and volume of information transfer on communication networks. This new type of communication is referred to as ultrafast communication, cf. (Miller, 2004).

In order to achieve all-optical networks, efforts are being made to develop and introduce optical communication hubs. Many fiber optic cables are already used for communicating optical signals over longer distances, but there are currently no optical alternatives for many electronic building blocks, such as flip flops, gates, buffers, memories, shift registers, and transistors.

Optical communication is not the only method for ultrafast communication. Wireless communication, using electromagnetic waves, is also considerably faster than electronic communication systems. The speed of wireless networks is often slowed down because wireless networks may involve electronic transmission at both ends of a data transmission. The development of all-optical building blocks will overcome this limitation for optical communication systems. Wireless systems are largely beyond the scope of this contribution, although this is a development that should not be ignored, particularly because it addresses the current limitations of fixed networks.

## **3. Exclusivity**

Although the introduction above may give a clue about what we mean with exclusivity, it is important to have a closer look at what exclusivity really involves. We consider this important because exclusivity is a term that is hard to grasp. It is even more difficult to qualify the degree of exclusivity of a particular network.

In this contribution, exclusivity is defined as an aggregated form of accessibility. Basically it can be stated that when I have access to the communication networks, I am included, and when I do not have access to the communication networks, I am excluded. Obviously this refers to the possibility of access, not the actual access. For instance, if a family has only one computer, the time of access will have to be divided somehow between the family members, but it is fair to state that all family members have access, even though it may be limited in time. Obviously this example becomes different if more people have to share one computer. Accessibility decreases considerably when people do not have Internet access at home, but only at Internet cafes. Internet access at work may be limited, as an employer may block particular pages or not grant Internet access at all.

Usually exclusivity is not a black or white situation, but a sliding scale. The skills of Internet users usually increase along with the amount of time spent using the Internet. However, there is a basic level of accessibility that can determine the exclusivity of a communication system. Take the example of filling out tax return forms. Minimum conditions for 'being included' in the digital service may include, for instance, two hours of Internet access at a private place. Not many people like to complete their tax return forms in an Internet café. Hence, without this minimum requirement, we consider people to be excluded, which is why tax authorities usually offer paper tax return forms as well.

However, exclusivity involves more than the frequency with which users can access communication systems and the time they can spend each time they have access. It is also about the number of people in society who have access. We are referring to situations in which many people have access for reasonable amounts of time (reasonable for completing the intended actions) with regular frequencies (regularly, so that no essential tasks remain undone), whereas others have not. If 90% of society has access and 10% has not, the latter group may feel

increasingly excluded. It may be interesting to do research on whether such differences in accessibility may be caused by differences in social context. Nevertheless, even if social contexts do not affect accessibility, they definitely result from it. That is, if people have access to communication systems, they are able to form broader social contexts than people without such access. Limited communication usually results in more isolated positions. This may even have cumulative effects, as the people with access may be in a position to take initiatives to improve their socio-economic positions, whereas people without access may become increasingly dependent on others.

It is important to realize that exclusivity is closely related to the availability of alternatives. Digitally offered services are not exclusive as long as there is an alternative service such as human interaction, an office in town or a paper form that can be used instead of a digital one. However, as indicated above, these alternatives are disappearing rapidly in many sectors. In many cases, there is some critical mass: if a particular number of people have changed to the on-line service, it may no longer be interesting or profitable to offer the off-line service. Based on market freedom, suppliers may cease to offer services off-line. Companies usually have no legal obligation to continue these services.<sup>1</sup> Once the critical mass of digital users is reached, the alternatives cease to exist, rendering the network exclusive.

Exclusivity is thus a form of aggregated accessibility, qualified with time and frequency of access and critical mass of users. It remains difficult to assess the (degree of) exclusivity of a particular communication system. As we will describe below, ultrafast communication networks may cause increased exclusivity. However, we will focus firstly on the main reasons for exclusivity.

#### **4. Reasons for Exclusivity**

What exactly is it that causes the difference between access and non-access on a larger scale? In this section, the two main reasons for exclusivity, i.e., costs and knowledge will be discussed. Obviously there are more reasons for people not having access to communication networks. For instance, network operators may refuse access to people who sabotaged the network in the past or, in extreme cases, people with dissenting opinions. However, we consider such cases of refusal to be too small to be significant to influence exclusivity. As mentioned in the previous section, exclusivity is about critical mass; therefore we investigate reasons that influence critical mass.

##### **Costs**

Probably the main barrier to access to most products and services, whether off-line or on-line, in modern societies is a financial one. Costs are often the main factor for people in deciding to purchase something. Access to communication networks is usually a product that has to be purchased. If costs are high, there will be fewer people who can afford to join the network. If costs are lower, more people will join.

It is for this reason that companies try to reduce access costs. A network is more valuable when more people are attached to it. What use is a phone, when there is no one else with a phone? This is known as Metcalfe's Law: the connections of a network increase in proportion to the square of the number of nodes. This has commonly been modified as: the value of a network increases in proportion to the square of the number of users (Martin, 2006). This is why most phone companies give away mobile phones for free. Obviously they do want to make money, so they sell subscriptions and add-on products. But basically they lower the barriers to access the network.

If a person has a limited budget, access to communication networks is usually not on the top of the priority list when it comes to purchases. Home, food and a minimum of clothing are obviously more basic needs. After these, communication devices may become an option. It is disputable whether mobile phones and Internet access are to be considered luxury goods. Some people have even suggested that they may be basic needs for people in modern societies. However, it may be fair to state that for those people whose budget is not exhausted after the basic needs, Internet access and a mobile phone have often more priority than luxury items like holidays, private cars and a second home. Obviously this is also related to the fact that network subscriptions are significantly cheaper than these luxury items, even though costs may accumulate considerably over time. When costs are a factor in network access, it may be that socio-economic groups with lower incomes more often lack access.

Costs of access may be different in the various stages of technological development. When a product is introduced, the first users, sometimes referred to as the early adapters, are often willing to pay for a product. They consider new technologies gadgets and are curious about them. However, when a technology is successful, larger numbers of people become interested. More demand often means higher prices. This is the stage in which a company has to earn most profit to compensate for its innovation costs. However, high prices and high demand often attract the attention of other companies, who will try to produce and market similar products. With increasing competition, margins (and hence prices) will decrease. Lower prices are usually possible, since large-

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<sup>1</sup> Note that this may be different for governments and public services.

scale production often offers a lower price per product. When prices are lower, more people will be able to afford the product and the market may grow towards saturation. In this stage, competition often starts focusing on other aspects, such as added functionalities and design, rather than price. Due to the variations in consumers' costs over time, the exclusivity of new networks may vary over time accordingly.

### **Knowledge**

Costs are not the only reason for exclusivity. There is another reason, more closely attached to the technological sophistication of the problem at hand, that we will indicate with knowledge. By this we mean the basic knowledge a user has to have to be able to use the network for its designated purpose. A person who wants to navigate on the Internet has to know basic things like how a mouse works, how websites can be found, how clicking on links works. For a user, this may sound rather obvious and straightforward, but there is a plethora of examples of bewildered first-time users of new technologies.

When the first televisions were introduced, there were viewers who used to talk to the people on screen. The first microwave ovens were used to dry laundry. The first computers asked users to 'press any key', but users could not find a key on the keyboard reading 'any key'. Many first-time computer users moved the mouse on the screen rather than on the table. When voicemail on mobile phones is not recognized as a recorded voice, people start talking to it. These are only some of the obvious examples; there are many more.

The bottom line here is that users need to be educated in, get acquainted with and get used to new technologies. Sometimes this may require so much of the users that they are not able to use the new technology. Whereas driving a car may be within the reach of most users, flying a plane is beyond most people. Sending an email can be as difficult as flying a spaceship for people who have never seen a computer.

When a particular technology requires advanced knowledge and skills of users, this may inhibit particular (groups of) people to use that technology. For network technologies, this implies these people do not have access, unless they are taught how to use it and have the necessary abilities and skills. As a rule, this means that more advanced communication systems are more exclusive.

It should be noted that it may not only be the sophistication of the technology itself that may exclude people from using it, user-friendliness may also be a factor. Obviously most users consider their computer a black box and rarely open it themselves. Most car drivers cannot repair their car when it is broken, but this does not prevent them from driving it. However, it is not only the user-friendliness that counts. A cyclotron can be made user-friendly, but the majority of people do not have a clue what it is meant for.<sup>2</sup> In fact, most computer games are based on limited user-friendliness, so that the user can improve his tactics and skills concerning the technology at hand.

Furthermore it should be mentioned that the new network technologies not only require increased skills to operate the technologies, they also require increased skills in judging information content. Whereas there used to be a scarcity of information, nowadays there is often an abundance of information available. As a result, people may lack overview of the information and may not find what they are looking for. A Google search resulting in 10 million hits may be as useless as a search resulting in zero hits. In both cases, a new search has to be performed. The main aspect of assessing information content is related to the reliability of the information (Vedder and Wachbroit, 2003), (Vedder, 2005).

As there is a correlation between education levels and welfare, the knowledge factor may often go hand in hand with the costs factor, discussed in the previous subsection. Combining the two factors may result in a synergetic effect. Hence, access rates to networks may be particularly low in socio-economic groups with lower incomes and lower education levels, lower than may be expected on the basis of the separate factors. This effect can be self-enforcing, resulting in increased polarization in society.

## **5. Effects of Exclusivity**

The two main effects of exclusivity are social polarization and the risk of manipulation. Social polarization may be caused by the fact that some groups in society may have access to networks, whereas other groups may not. Limited access may also be the case for the suppliers of information. When there are only a limited number of suppliers of information, this may cause monopoly positions in which the suppliers of information might manipulate information.

### **Social Polarization**

Modern information and communication networks are not always easily accessible. Usually an access device is required, such as a computer, cell phone or TV. In addition, being on the network usually costs money. As a result,

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<sup>2</sup> A cyclotron is a particle accelerator used for scientific research in nuclear physics.

there are many people in the world who lack the resources to actively use modern information and communication networks. Lack of access has aggregated effects (i.e., some groups having access and some groups not having access) and cumulative effects of access (i.e., some individuals never having access and some individuals always having access).

Ultrafast communication systems may influence the ways in which information is delivered and to whom. As a result, distributions of information may change due to ultrafast communication. Particularly when access to information is expensive, information may become exclusive to some people who may be able to pay for it. Others, for whom information is not affordable or those who are being denied information for other reasons, will be lacking access to this information. This may raise ethical and social concerns. Ultrafast optical communication systems are a typical example of a new sophisticated technology. In the early stages of introduction, it is likely to be expensive. After some time, when the technology becomes more and more common, it is likely that there will be decreasing costs to use the networks.

If there are no alternatives to ultrafast communication systems that make access to information considerably less expensive, this may result in social polarization. Similar to the current social division of people on this planet who have access to the Internet and those who have not, there may come into existence an exclusivity of ultrafast communication systems on a social-economic basis. This may typically result in cumulative effects for those affected. For instance, many companies are increasingly offering products and services on the Internet because this is less expensive. Typical examples are Internet banking or Internet shopping. People who have no access to the Internet for economic reasons are not able to buy the cheaper products or services. Instead, they are forced to use the more expensive off-line shops. This makes it even less likely they may get into a social-economic position that will grant them access to the Internet.

It is hard to predict whether there will be alternatives to ultrafast communication systems. At the moment, research is being done on other systems that have even more potential. Particularly nanotechnology and quantum computing are promising technologies. If these technologies are further developed, it is likely that they will build on or replace ultrafast optical communication systems. This may reduce the exclusivity of optical systems, but obviously these new technologies may be similarly exclusive.

Exclusion is not only a question of having access or not. For instance, the reliability of the information may be an aspect that adds value to information. Typically this may involve that more reliable information is more expensive. In some cases, information that provides a rough indication or overview may be sufficient but in some cases very detailed and accurate information may be required. However, when budgets are limited, this may result in choices for information and information providers with limited reliability. As a result, ultrafast communication systems may create a tendency to use cheaper information that may also be less reliable.

Technological developments are not going to be halted because some groups in society are not able to keep up with these developments. Nevertheless, there is a responsibility for those who are included in the networks to keep into account those who are excluded from the networks. In some cases, this may involve that functionalities are not only offered on the networks, but also in the off-line world. Obviously, for commercial purposes, this may be more difficult. Since it is unlikely that society will subsidize off-line transactions when on-line transactions are much cheaper, it may be expected that society is going to accept exclusivity as a fact of life.

### **Risk of Manipulation**

The previous section dealt with exclusivity of networks from the perspective of users. However, with sophisticated technologies, it is likely that there will only be a limited number of suppliers of these technologies as well. Since technological innovation, research and development costs a lot of time and money, these processes are often shielded in order to allow companies to exploit their inventions. Particularly in the early stages of the introduction of a new product, there is usually only one supplier. This supplier tries to exploit its invention as much as possible, until, after some time, competition arises (see also Baxter, 1995). This usually occurs when patents expire or when the production process is revealed. The latter often results in copies, sometimes illegal ones in countries without patents. The first suppliers have a monopoly position that they may want to use for maximum benefit. Examples of this mechanism are abundant, for instance, for Coca Cola, for Microsoft and for most new medicines.

There is nothing wrong with a company trying to earn back its investments. However, a monopoly position might result in manipulations that may be qualified as abuse of the monopoly position. In 2004, Microsoft was fined almost €500 million by the European Commission for abuse of their (almost) monopoly position (CNN, 2004). Microsoft settled other related conflicts for even higher amounts, such as with IBM (€700 million), see Financial Times (2005) and Sun Microsystems (€1.4 billion), see Financial Times (2004).

In such situations, suppliers of information play a different role from suppliers of regular products and technologies, because they can manipulate the information they provide. This is not merely a theoretical possibility, as the example of Internet search engine Google may show. In recent years, Google has become by far the most often used search engine. Google's search service uses a particular algorithm to provide information links on the Internet. However, the search results can easily be manipulated by Google. This happened when Google

started providing its services in China. The Chinese government had negotiated several conditions before granting Google a license. Particularly searches on politically sensitive subjects, such as human rights, Tibet, and Taiwan, were blocked. Furthermore, the secret service was informed on which computers (IP addresses) these searches were performed. Similar examples of Google blocking particular websites occurred in Germany and France regarding particular websites about Holocaust denial (Zittrain and Edelman, 2003).

Ultrafast communication systems may result in a new balance of information demand and supply. In such a market, the suppliers of information may manipulate information content. For instance, customization (sometimes referred to as personalization) is a way of providing particular products, services or information that a consumer (supposedly) wants. Manipulating the content of information may not only take place for financial reasons, but also for political ones. Particular information may be even censored, which may involve, for instance, deleting messages (partially or entirely) or changing the content. Obviously the controllers or providers of information may also use ultrafast communication systems for distributing their own messages, e.g., by means of spamming. Scenarios like these may lead to violations of freedom of speech, and excluded people may not be able to influence any further developments.

Apart from manipulating the content of information, system controllers may also manipulate the communication channels, i.e., influence who connects with whom. This is comparable to online cross-selling: when buying a particular book on the Internet, the bookseller usually provides titles of books that may interest you as well. In general, it is considered good service to provide additional titles, and the bookseller obviously intends to sell more books with this service. The same customization can be done with communication channels: people with similar interests can be advised to get into contact with each other. In this way, connections between particular individuals can be stimulated, but it is obviously also possible to prevent particular individuals from connecting to each other.

As indicated above, these scenarios, in which ultrafast communication systems replace existing means of communication, may affect freedoms of information and communication and possibilities of public control. When information is scrutinized and censored before it is made public on the communication networks, there is the risk that particular messages are not disseminated. The example of Google in China illustrates how freedom of speech may be limited in cases where the suppliers of information have a monopoly position. Particular information may be withheld from people without them being aware of it. Their inquiries may be registered, for instance by surveillance and prosecution authorities that may take subsequent action.

## **6. Conclusions**

Ultrafast communication networks are likely to introduce two barriers of access to users: costs and knowledge. These access barriers may result in excluding groups of people from access to these networks. In the early stages of introduction of new technological developments, it is likely that the costs will be kept low in order to get the critical number of users that communication networks usually require. After that, a profit has to be made to compensate investments, and costs will increase. Costs may decrease again after the introduction of more competition. Generally speaking, the number of users may depend on the costs involved and even though costs may be kept low, it is likely that there will always be groups (small or big) of people who are excluded. The same goes for the knowledge that is required from users of sophisticated networks. In general, older people seem to have more trouble adapting to the latest technological developments. New technologies may expect more of users regarding education levels and adapting to new concepts. This may also result in excluding some groups of people from access to communication networks.

When larger groups of people are excluded from the networks, this may cause social polarization between those who are included and those who are excluded. Another effect of exclusive networks may be the limited number of providers of structure and content, which may lead to manipulation of the information provided.

Here we will offer three suggestions that may help to deal with these effects of the exclusivity of ultrafast communication networks. The first and second are aimed to decrease the exclusivity of the networks by addressing the access barriers, the third addresses alternatives to exclusive networks:

- Remove the costs barrier. The first reason for exclusivity is the cost involved. There may be several ways to remove this barrier. For instance, the costs may be compensated, or free access points, such as in libraries, may be provided.
- Remove the knowledge barrier. The second reason for exclusivity is the knowledge required. There may be several ways to remove this barrier. For instance, by educating these groups and by providing more user-friendly access points.
- Ensure off-line alternatives for basic needs. Some networks will be exclusive when the barriers above cannot be removed. For most commercial networks, this is not necessarily a problem. It may become a problem when there are basic needs involved for the users. Booking a flight ticket is generally not

considered a basic need, but buying clothing or completing tax returns may be considered so. For these applications, it seems reasonable to provide off-line alternatives.

Current communication networks, such as the Internet, do not show large-scale social polarization and manipulation of information. Although ultrafast communication systems are likely to show these effects on a larger scale, the suggestions above may help to minimize or avoid these effects. Exclusivity of networks is not necessarily a negative thing, as long as some choices and alternatives continue to exist for both those who are included and those who are excluded.

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