

On convergence

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Abstract

Convergence means that different entities come together or approach each other. During the last years the term convergence has become a buzz-word for the development of new technologies in the field of digital communication. Convergence is not a new technology but a term for the process of technologies converging. The process has started some years ago. This text is about some first results of convergence.

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A common interpretation of the term convergence is that different technologies are unified to one technology that covers a whole field of applications. A kid that grows up in today's world, might assert that there have never been different technologies. In a few years this kid could state that when he was young different industries created artificial incompatibilities between one and the same technology in order to sell it on different markets. Of course we know that this is not true at all - when we were young a telephone had nothing to do with a radio and for us it still makes sense that we distinguish between telecom companies and radio broadcasters.

From the technical point of view, it is not necessary anymore to distinguish between a telco and a radio broadcaster. Both companies deliver audio services and charge money for it. That it makes practically no sense anymore to call the players of the audio-service industry by different names is a good sign that a scientific revolution in the sense of Thomas S. Kuhn has taken place. Convergence has already happened. The result is, as Kuhn has worked out in his book "the structure of scientific revolutions", that some words that are used to describe digital communication become obsolete and some others become more important.

The following sections describe my personal opinion of which are these new entities that build the world of digital communication after convergence has taken place.

1 The user

A user uses technology to get things done. There are several reasons why a user might use a piece of technology, but all technical devices have one thing in common: they are tools that are programmed to do certain tasks the users might expect them to do. Thus the first topic to consider thinking about digital communication is:

1.1 User intention

As long as nobody has built a computer that passes the Turing-test, my definition of communication is the exchange of information between human beings. Neither man-machine interaction nor the interaction between a man and his cat is communication. Man has invented tools to make communication more or less independent of time and space. Communication tools rely on the storage of information (e.g. the Gutenberg Bible) and its transmission over a distance (e.g. sending a letter).

Most communication technologies require that the transmitted information is more or less compressed. Compression of information may happen in several ways. A very effective way is that a human being (medium) transcribes the sensations he has while receiving an information from a sender into written language before transmitting it to a receiver. The receiver gets only the information that is transmitted through the subjective medium. The transcript consists of words that are the least common denominator of the impressions that transmitter and receiver share. If the medium transforms the information into digital code (e.g. Morse) before transmitting it, we can speak of digital communication.

Once an information is digital it can be transmitted without losses. Even if the signal of a morse code is nearly undistinguishable from noise the information it contains

is still the original one. The receiver of a digitally communicated document always receives the original document without losses or disturbances. If he decides to store it he owns an identical copy of the original.

The first purpose of digital communication between human beings was probably independence of time and space. If some aspects of an event can be transmitted to other places the audience does not necessarily have to attend the event. So maybe the primary motivations to use digital communication devices are laziness and the want to save time.

What makes a human being to a user? It is the conviction that his life and well-being depends on the access to information or the ability to communicate with others wherever he is and whenever he wants. He is convinced that his communication abilities make him superior to his neighbour and help him survive competition. Some users even think that with a little help of their communication devices they become independent of their bodies and their rotten egos. At least this is what the communication industry suggests that human life nowadays is about.

In other words: communication is a drug. The decision to be a user is utterly subjective and influenced by the drug lords of the communication industry. However, in the present world digital communication has become a major economy factor and created many jobs. We cannot imagine anymore living in a world without digital communication. We are users. So the next topic we have to discuss is:

1.2 User requirements

Communication is a very personal thing. So first of all a user should require control over the devices he uses to communicate digitally. Control means for example that a sender wants to know what happens to his voice when it is compressed by his phone and how his voice sounds in the ears of the receiver.

Control also means that a user wants to be able to declare some information (e.g. information about himself, a phone call, a letter) private and be able to prevent third persons from getting access to this information. Some informations may be for friends but not for strangers. Digital information does not have a lifetime. Once it is out of the user's head and digitized, it is very hard to cancel it. Therefore a user wants to be able to clearly define who receives his information and who not.

Communication devices should be as independent as possible from the providers of communication services (following the feeling that being drug users, we do not want to be dependent on one drug dealer).

A whole industry profits from the fact that presently users cannot control their devices at all. For years direct marketers have been cooperating with credit card suppliers and software companies to deal the personal data of their customers. As a matter of fact private data are exploited by applying hidden scripts and sophisticated log file analysis to digital communication. That users are spammed with advertising they never asked for is partly their own fault: As long as their device works, very few users are interested how it works (e.g. what software it uses, the access privileges to personal data files). Very often the factory configuration of a software (e.g. Netscape) is insecure. Although the configuration can be changed, only a few users bother.

Thus, below the convenient surface of digital communication, the communication industry tries to get ever more control over their users. Too well informed users are bad for the industry. Cell phone users for instance resist to change their providers, because they had a hard time learning how to use their phones and do not want to lose their phone numbers. Therefore for the cell phone company every (stupid) customer is worth thousands of dollars.

It is obvious that the user can only have ultimate control over his tools if he understands them (e.g. understands the business model of the provider), owns them (e.g. that he owns the source code of the software that runs his devices) and knows how to use them (e.g. how to program his device).

Apart of control a user has more requirements to his digital communication devices: the communication tools should be always available (independence of time and space), they should be adaptable to the his situation (mobile devices, fixed devices) and they should be trustworthy. A most common misunderstanding is that information is more trustworthy when received in the form of pictures or sound. Just because his senses of seeing and hearing are addressed a user may believe that a thing really happened or an information is trustworthy. As a clear result of this psychological fact, an industry that has the means to manipulate audiovisual information is able to manipulate the users (e.g. war propaganda).

Of course today every user with a videocamera and a PC is able to create, manipulate and spread audiovisual information. At the end of the day it is the decision of the user which information he trusts and which not. Therefore users start building networks of trust in order to exchange information over secure communication lines.

Last but not least many users see digital communication as part of their social life. Users who move in public net-space should have the chance to speak freely. For any employer can trace what an employee has uttered when he was plugged in, sometimes it might be useful for a user to stay anonymous. The right to access digital communication at all as well as the right to communicate anonymously are user requirements to digital communication.

2 The device

A user uses a device to access digital communication. As the senses of a human being are susceptible only to analog signals the device must contain an A/D (analog to digital) converter for user input and a D/A (digital to analog) converter for output to the user. The user communicates with the device by the user interface - the user interface is analog on the user side and digital on the side of the device. Apart of the user interface the device may have a application programmer interface (API) and a programmer interface. The device may also have some interfaces to other devices (e.g. ethernet port, serial port). The different interfaces show that there are different groups of users: the "end user" and the programmer. Each user group has different requirements to a device.

2.1 User interface

The user interface of a device should show at first glance what the device can do for the user. If it is a communication device it should display what services may be accessed or used through the device. The user interface to the services should be standardized so that the user can access the same service using another device without having to learn a new interface.

A good user interface makes the user independent from a certain device. If he wants to use the same service with another device he is free to do so. A killer feature of any user interface is standardization. The more disposable and exchangeable a device is, the better it is for the user. Once users learn that a device is nothing more than a tool to access a service they will see that any personalization of the interface or any proprietary feature of the device is only a loss of time. For obvious reasons users will also have to learn not to store personal data on insecure devices.

The device industry naturally cannot accept that their devices should become disposable or exchangeable. By cooperating with service providers they combine their devices with certain services. This strategy is deemed to fail - service providers know already that only platform independence gives them access to the maximum number of users. The failure of proprietary online-services in the early days of world wide web is an example for that. Today the world wide web can be accessed by a variety of browsers that run on many different operating systems and devices. That it is impossible to regulate services by introducing blocking devices is proven by parental control devices. One of the few privileges of the internet user is the freedom to choose the device he uses to access the world wide web.

2.2 Programming interface

Some users are programmers. For a programmer a device is just a piece of hardware with a certain operating system that runs a software to deliver some services. The programmer is very much interested to configure a device so that it satisfies his demands. For a programmer configuring the device means programming it. All the programmer needs to write software for a device is documentation of the hardware, a command line interface to the operating system and a compiler that translates the source code of his software into executable code.

For a programmer the preferred interface to any device is therefore a shell with a compiler. The operating system and the application software that comes with the device should be Open Source (preferably Linux).

By opening the programming interface the device industry will lose certain assets: it will not be able anymore to sell one and the same hardware with different application software as two different devices to the same user. A device is just a piece of hardware that does what the user wants it to do. If the user wants it to do more he uploads another software. He may buy the software from the device industry or he may download it from the web site of a programmer.

The industry still differentiates between devices designed for the consumer (consumer electronics) and devices for professionals (computers). The different devices target different markets. Consumer electronics comes with sophisticated user inter-

faces for the (keep it simple and stupid) masses and no programming interfaces at all. Computers come with crappy user interfaces for consumer services and more or less sophisticated programming interfaces.

In the world of convergence a piece of hardware is a device. The difference between so called consumer electronics devices and computers simply does not exist anymore. Cell Phones, Walkmen, Radios are audio devices. Laptops, TV sets, PCs are video devices. If the device industry does not surrender the control of the programming interface to the users, the users will take control by installing Linux on the devices.

2.3 Independence

The device itself should not depend on the other entities that constitute the world of convergence: user, service, network. The control of the device should be entirely in the hands of the user.

If a device is independent from the habits of a certain user, different users can use it. This independence is only a question of good user interface design. The less a device depends on a certain software the more services may be accessed through it. The independence of software is only a question of good software design. Concerning connectivity independence means: the more possibilities a device has to access the Net the more flexible it is. This independence is a question of hardware design and the underlying network protocols.

It seems that the value of a convergence device to the user is directly proportional to the (time/ space/ service/ network) independence it gives him. The ideal communication device offers a good interface to the primary service it is supposed to deliver. Embedded in the device is a technically well documented hardware running Linux or any other Open Source operating system. The software of the device is also well documented by being available as source code. For a programmer it is possible to write software for the device. For a user it is possible to extend the capabilities of his device by uploading software.

Digital communication between users takes place by the exchange of audiovisual information, sound, still pictures, text and many other data types. Communication devices may be distinguished by the number and the quality of services they are able to deliver. The value of a device might depend on its physical size, the resolution of its display, the different networks it can access, the bandwidth of data it is able to process and many other factors. Different devices will be best for different services and different users in different situations.

A relatively new aspect for the value of a device is its openness - devices that can be programmed by the user can easily adapt new services and new applications. They are more compatible with the world of convergence and therefore more valuable.

3 The service

Technically, a digital communication service is nothing more and nothing less than moving some data from a sender to a receiver. Nevertheless the digital communication service industry is probably the fastest growing industry in the world. Partly this is

justified because the service industry creates value by assembling data and packaging them into services (e.g. Web Sites). But the biggest part of the service industry consists just of the dinosaurs left over from the century of analog communication. These players try to block the development of digital communication as long as possible because digital communication is their death. By closing access to the networks they own, by allowing only certain services to run on their networks, by controlling the technology of the devices that are used to access their networks they try to keep their influence.

3.1 Service providers

Today the telco dinosaurs call themselves service providers and offer services like telephony, cable television and things like that in connection with the access to their networks. It is obvious that these so called services are completely independent of the providers that bring them to the user. What they call services consists merely of network access and a lot of marketing. But providing network access is the job of network providers who form another part of the convergence world.

In order to define the role of service providers in the convergence world one has to ask oneself simply the question: what is a service and what service am I willing to pay for? A communication service may consist of gathering some meta-information that makes it easy to the user to find the piece of data he is looking for (e.g. search engine, electronic programm guide). Of course the information itself (e.g. a piece of music, a film) is also of value. But it is not a service, it is content. Unless the service provider has acquired the rights to distribute this content the user should not be forced to pay for the privilege to access the content (a so called gatekeeper function only makes sense for exclusive services and content). Which raises the question if content distribution is a service at all and if it were not better that a content owner distributes his content and charges for it directly.

Is telephony a service one should pay for? Is email a service one should pay for? If a user is only willing to pay for services that give him additional value to using his communication device the answers are simple: neither for telephoning nor for exchanging email the user of a digital communication device needs a service provider. Today's communication devices are perfectly able to digitize voice, packetize it into data and send it to a receiver. Once all devices have unique ip addresses (e.g. IPv6 addresses) the so called telephony providers will lose their monopoly to switch calls and charge money for it.

3.2 Classification of services

Anyway, there are plenty of digital communication services today - some are for free, most are not. As we saw before, services are nearly independent from the devices that are used to access them. Much stronger they depend on the networks that are used for the transfer of their data. Thus the value of a service is basically connected to the cost of its network transmission. Other costs may be caused by data storage, the exclusiveness of the service or and additional value like convenience. A classification of the services sheds some light on their relative cost.

The main cost factor is the bandwidth a service uses on the network. Video needs more bandwidth than audio. Voice transmission, graphics and text need even less bandwidth. In the case of broadcast and multicast services many users share the same service. So the cost of a service can be estimated by relating the cost of bandwidth to bring the service to every user to the number of all users. According to this model exclusive services like video on demand are more expensive than non-exclusive services.

Another cost factor for a service is whether it is real time or not. For transmitting video, audio or voice services the network has to guarantee a certain bandwidth - the user pays for so called quality of service (QOS). If the network does not guarantee QOS the user may have the option to wait until the data are downloaded to his device and replay them later (e.g. On Demand services). The cost of such “low priority bandwidth” might be less.

Service	Users	Bandwidth	Timing
TV Broadcast	unlimited	2-6 Mbit/s	real time
TV Multicast	limited	2-6 Mbit/s	real time
Video On Demand	one	2-6 Mbit	not real time
Radio Broadcast	unlimited	150 kbit/s	real time
Radio Multicast	limited	150 kbit/s	real time
Audio on Demand	one	150 kbit/s	not real time
Video Conferencing	two	1-3 Mbit/s	real time
Telephony	two	16 kbit/s	real time
WWW	one	16kbit/s	not real time
email	limited	16kbit/s	not real time

Table 1: Classification of services

The value of a service is of course a subjective measurement. It depends largely on the communication habits and the preferences of the user. The classification of services however shows that it is possible to deliver the same content more or less expensively. Rich people can afford to say “I want the service here and now”, the others will be free to organize in user groups and share the costs.

4 The network

Without a network convergence would be impossible. “The Net” connects the devices that are used by the users to communicate with each other. Digital communication can be categorized into services that depend on the quality of the networks they use.

Different physical layers constitute the Net. Large distances may be crossed by glass fibre or satellite connections. For smaller distances there are copper wires, cellular networks, radio networks, coax cables, infrared and so on. Briefly, the Net consists of electromagnetic waves that flow between devices through cables or through the air.

In order to transport digital data over the network the electromagnetic waves need to be modulated. Different networks require different ways of modulating the waves. On top of the modulated waves sits a network protocol called IP (Internet Protocol).

This is a simplification - there are other protocols besides and beneath IP but as a matter of fact every convergence device sooner or later speaks IP.

For a communication link from one device to another both devices need IP addresses. Today not every device has a unique IP address - it is quite usual that network providers supply a dynamic IP address to a device when it connects to the Net. The reason is that the network providers do not have enough IP addresses for their customers. With the improvements of the IP protocol (IPv6) dynamic IP addresses will not be necessary anymore.

If every device has an IP address and every network can transport IP data the convergence scenario becomes once more simple: a user that uses a device can not only choose the service he accesses with the device but also the network his device uses. Again the value of different types of network connections to the user is subjective.

A first criterion for the value of a network is its availability: If the user stands in the middle of a desert and wants to connect to the Net he has not much choice - probably he will connect to a satellite network and pay much money for it. In a big town the situation is different - the user may choose between ten different ways of accessing the Net.

Convenience is another factor - if the user wants to be mobile he would rather access a wireless network than connecting by cable. A third factor could be quality of service - dependent on what services the user accesses some networks may have advantages to others.

4.1 Network providers

Which network a user chooses to plug into the Net is of course also a question of money. The cost of network access depends on how much bandwidth a user needs for accessing a service, how many data are transported to and from the user, how reliable the bandwidth is over the time and what all the other users of the network are doing while the user accesses it. At the end of the day the amount of cash the user has to pay for network access depends on his communication habits and lifestyle. For there are different network providers who offer network access the user is free to choose the most convenient one. The network provider is not an anonymous institution - for the user in a way he is a person of trust. Here are some qualities of a network provider that might influence the user's decision which network provider to choose.

Very important for the user is the trustworthiness of his provider. Every movement a user does on the Net, every connection, every service he uses, is logged by his network provider. Government laws force providers to do this. For the user it is worth money that his network provider keeps his logfiles private. The trustworthiness will be measured by the know-how and the technology the network provider offers to protect the privacy of his customers.

Other important qualities of a network provider are his reliability, availability and quality of service. Dependent on his lifestyle the user might expect the same quality of service wherever he is. Every provider should offer as many ways to access the Net as possible. This does not imply that he needs to own the lines of the network - one could think of roaming services already known from cellular networks.

As said before, it is important that a network provider does not mix up network access and services. For the independence of the user it is necessary that his access to services neither depends on proprietary devices nor on the network provider. Of course this service independence stays in strong contrast to today's telcos strategy. Once the users learn that the prize for independence (of device, service, time, place) is independence (of the network provider) this will change.

If a network provider offers support to his customers he should keep in mind: if he is not able to support a user having problems with a certain device that runs a less known operating system, it might be a reason for the user to change his provider. Technical support is a service. Users expect their network provider to be technically competent.

Few network providers own their network infrastructure. But as bandwidth is a good that can be traded on a stock market, network providers sooner or later will break the bandwidth they sell to their customers. By subscribing to a certain network provider the users give the network provider the ability to forecast their demand of bandwidth. This enables him to buy cheap bandwidth and to make a profit. For bandwidth will be dealt in public the users will be able to calculate the profit their network provider makes. Therefore the users will expect some transparency concerning the prize for bandwidth and the profits their network provider charges for service.