



Figure 1. How the Phone Company sees you...



Figure 2. Before fiber optics there was the telegraph wire.

The Internet: a clash of cultures

Rob Blokzijl

Today we take the Internet for granted. It has always been there, and it is everywhere. We can hardly imagine a life without the Web, without e-mail, without Skype, without BitTorrent (especially our children), without whatever you can think of. Also the Internet is everywhere; on our computers be it a desktop or a laptop, on our mobile phones, on our fridges, TVs, gas stoves, door bells, you name it – it is there.

And when you think it is not there, it is just around the corner: your old fashioned analogue telephone landline terminates at a short distance from your home in a magic box around the corner and then suddenly becomes a digital, Internet Protocol (IP) based service handled by an optical fiber infrastructure. And no 'connection' exists any more – your packets are delivered on a best effort basis. Of course, you still pay for connection setup, call duration, and distance. The Phone Company has to make a buck, after all. That is their culture.

So, the Internet is everywhere, always, and it is mostly free. For a modest monthly fee one can have all the services that have ever been invented in the world of telecommunication. But – twenty years ago there was none of that. What happened between then and now? Let us go back a few years and look at the history of modern electronic telecommunications systems. As always, history explains most of today's realities.

In our case modern history of telecommunication starts in 1839, when William Cooke and Charles Wheatstone (yes, the one of the bridge) succeeded in transmitting an encoded message over an electrical subsystem (i.e. a copper wire) between Washington and Baltimore. A new age was born.

The early age of the telegraph is an interesting one: everyone and his dog invented his own, and of course the best, system. Unfortunately, these systems did not interwork. At the boundary of one telegraph system there is a man receiving incoming messages, writing them down, and transmitting them onto the next system manually. The application gateway was born!

The early telegraph system was mainly used by national governments for their normal diplomatic exchanges. And they didn't like the system: it was slow and there were too many middlemen reading their messages. In 1860 it took 17 human gateways to get a message from Berlin, the capital of the kingdom of Prussia, to the western border of the country.

So, governments got together and decided that they wanted a better system. In 1865 the International Telegraph Union was created by Governments in order to come to a single, unified International Telegraph system. And it worked. Most countries adopted the simple model: one country, one telegraph company, and the government owns and controls it. Well, that sounds familiar: it could be the Soviet Union party system, or the Dutch PTT until the early '90s.

This was a great success. So when telephony came about in 1876, and wireless telegraphy appeared in 1896, and public radio appeared in 1920 the same model was applied. The good old International Telegraph Union changed names, its mandate was expanded several times, and it was still the governments and their state monopolies in telecommunications that called the shots. In 1947 the final reconstruction took place. The 'International Telegraph Union' was now named the 'International Telecommunications Union' (ITU), and was reconstituted under the newly formed United Nations charter.



Figure 3. A black phone (or a grey one)...



Figure 4. Plus ça change...

as an International Treaty Organisation, and made a 'Member of the UN Family'. This means in practice that only UN member states can be ITU members, i.e. national governments. This is fine, as long as you as a government own and control your national phone company. This was normal in 1947, and many years to follow. In the Netherlands it has been the 'Ministerie van Verkeer en Waterstaat' (Ministry of Transport, Public Works and Water Management) that until the early 90's fully controlled the Dutch PTT.

A powerful department of civil servants, the 'Hoofddirectie Telecommunicatie en Post' (Head Directorate Telecommunications and Post), decided that your phone at home came in two colours: either grey or black. They also decided who would sit on the board of the PTT.

So far, so good. Until the late 60's we were all living in a simple but happy world. Telecoms was handled by your government, via your national phone company. And they decided what you wanted. You had a dumb terminal at home: a black telephone, or grey if you were being difficult. And the services you got were the ones provided by the network, i.e. the PTT, i.e. the Government. And nobody ever asked what you really wanted.

Then suddenly history changed on October 4, 1957, when the Soviet Union successfully launched Sputnik I. The United States president of that time, Dwight Eisenhower, decided that the US had a 'Science Gap' with the USSR, and told the military to do something about it. And thus ARPA was created: the Advanced Research Projects Agency. ARPA endeavoured on many fields of research, most of them of a fundamental nature – not military oriented. One of these projects was to investigate how to better use the scarce computing

facilities in US universities. The answer was in place 20 years later: a working version of the ARPAnet, a precursor to the Internet.

ARPAnet was a revolution in telecommunication: no longer was the copper circuit the stable connection between Alice and Bob, but a service that did a best effort to deliver digital packets between two parties, without any guarantee of delivery – a best effort service.

This was the start of the 'Cultural Divide'.

The traditional phone companies on the one hand argued that no decent service could be delivered based on an a priori undetermined network service. The ARPA network researchers argued that in the first place a decent network (i.e. the phone companies) should deliver a certain quality of service, and secondly that a next layer of software would take care of packet loss anyhow. In modern terms: you will lose packets on the IP (Internet Protocol) level occasionally, but you will recover on the TCP (Transmission Control Protocol) level. Hence, we describe the Internet as TCP/IP.

Since the early 70's we have seen these interesting discussions between the phone companies, monopolists, state owned bureaucrats, and the free thinking researchers from universities in the USA. But not only in the USA: Europe has played an important role as well. One of the first theoretical studies on packet switching networks has been published in France in the 60's; a thorough study on a first implementation and operation of a packet switched network was not published in the UK for reasons of national security. This was in the 70's.

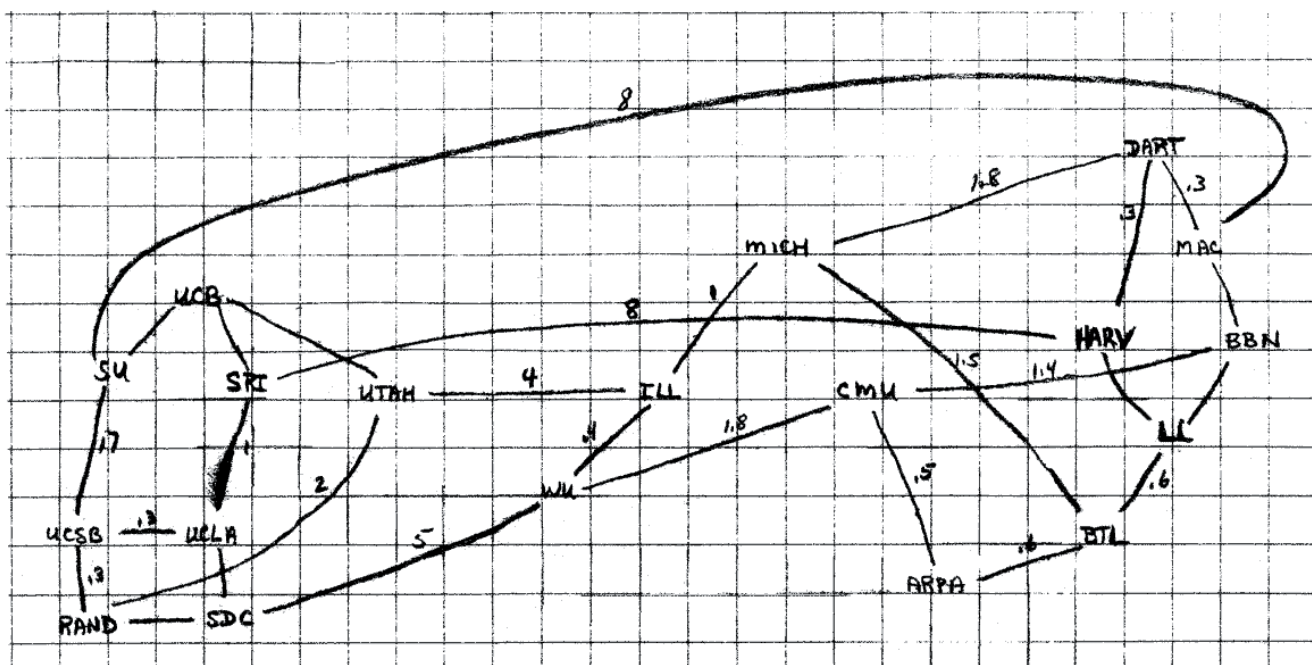


Figure 5. Sketch of the ARPANet structure in 1969.

So, in the early 80's we had this simple situation. The research and academic world had developed a network technology that could not work according to the ITU and national governments. On the other hand these same national PTT's and governments were working on their own way of doing networking: ISO-OSI was the acronym, meaning ISO Reference Model for Open Systems Interconnection.

In those interesting years in the 80's two major developments happened:

1. The University of California at Berkeley released a version of the UNIX operation system that contained the full set of Internet protocols for free.
2. The European Commission and the US government decided that ISO OSI was the way forward, and they committed a couple of billion ECUs and USDs to the promotion and introduction.

The European PTTs were very happy.

They did not have the products or services, but the alternative, i.e. the Internet had now been officially 'verboden'. So, they could sit back and relax.

Not.

The PTT attitude was simple: we own the network, we decide what you want as services, we install that, and you have only our dumb black phone (or grey, you have a choice after all). And if you want to do different things, we don't allow that.

So, when in 1987 NIKHEF ordered a private leased line from NIKHEF to CERN from the then Dutch PTT, this was refused. It took more

than 9 months, and the intervention of SURFnet and the Ministry of Economic Affairs to get this line delivered. A different culture. You don't want this, so we will not sell it to you. We have equivalent services that are a thousand times more expensive. You better buy those. And you don't know how to run a network, anyway.

This was the first time NIKHEF got to know the culture of the Elephant PTTs. And not the last time. Since NIKHEF got involved in building networks on an international scale, we have not stopped being amazed by the conservative, if not stupid attitude, of the traditional carrier service companies.

But this is not a real surprise. Today, a typical telco, that grew out of a traditional phone company, still operates on a few simple principles. The principles are way out of today's realities, but that is life in a company that got used to have a safe monopoly for at least a hundred years, protected by a friendly government.

These principles are:

1. We own the network
2. We decide what is good for you
3. So, we invent services that we will sell to you
4. And you will be happy, and you pay

These are the principles of the old culture of the black phone (or grey). Today the world is different. Now the users' principles rule:

1. You own the network, but we use it
2. We decide what we want to do with it (think: skype, web, bittorrent, etc.)
3. no thanks, we don't want your services
4. and we will pay only for transport, not services



Figure 6. The Internet now.

Now this is something new for the phone company. Users telling the company to go away. We want your transport, not your services. On the Internet we do our own services ourselves – thank you.

This is a fundamental cultural difference from the good old days. The good old days were the days with the telco principles above: we own you. The new days of the Internet are: go away, we make our own services.

What does it mean: 'Our own services'? Well, think WWW. Think Skype. Think BitTorrent, think Grid. Services invented and run by the users, not the telcos.

So, what are the telcos doing today? Simple, reinventing their old wheel. And the wheel today is called: mobile phone. At the ITU World Expo 2006 in Hong Kong you could not be seen at the Expo unless you had a new mobile phone application. Really impressive: control your gas stove at home from anywhere in the world by your mobile phone! That is what we always wanted and have been waiting for for a long time.

However, at the Peoples Republic of China pavilion, there was luckily a fresh wind: the PRC is investing umpteen billions of their yuans in 'Distributed Grid Computing'. So, what is this – a new cultural revolution?

Yes – the Chinese government is going for Grid computing. No big deal, because so is the EU. The nice thing in both cases is that the money goes to science, or at least to the requirements of science for computing. The culture might still be a bit different, but at least this time the governments of the world seem to realise that they should

provide resources, and not demand politically correct outcomes. The good old telcos of this world however, the Phone Companies of the past, have not grasped their cultural problems at all. They still moan about things, no – visions, like 'Triple Play' (sooooo 2 years ago), or 'convergence' (soooo last year). And today they are still thinking about a catchword for next year.

Let us hope they do not find 'Grid' as their next stock market phrase.

Grid is a development that is new and exciting as a further step forward for the Internet. WWW last century, GRID today. It is exciting that NIKHEF is at the forefront of GRID developments, as NIKHEF was one of the original developers of the World Wide Web. And one of the original builders of the Internet in Europe.

The Internet grows – in size and in functionality. The growth in size is a matter of the market today: commercial companies take care of the growth of the Internet in terms of users, bandwidth and geographical coverage.

But the growth of the Internet in functionality takes place in the old dark corners of the first Internet days: Universities and Research Institutes like NIKHEF are still at the forefront of developing new technology on the Internet. NIKHEF has this long tradition of building the Internet. From the first 64kbps international line between NIKHEF in Amsterdam and CERN in Geneva (also the first Internet connection between the two countries), up to the leading role that NIKHEF has today in new developments for GRID computing. And we should not forget that NIKHEF is a founding partner, and a prime hosting partner, of the single largest Internet Exchange in the world (AMS-IX).

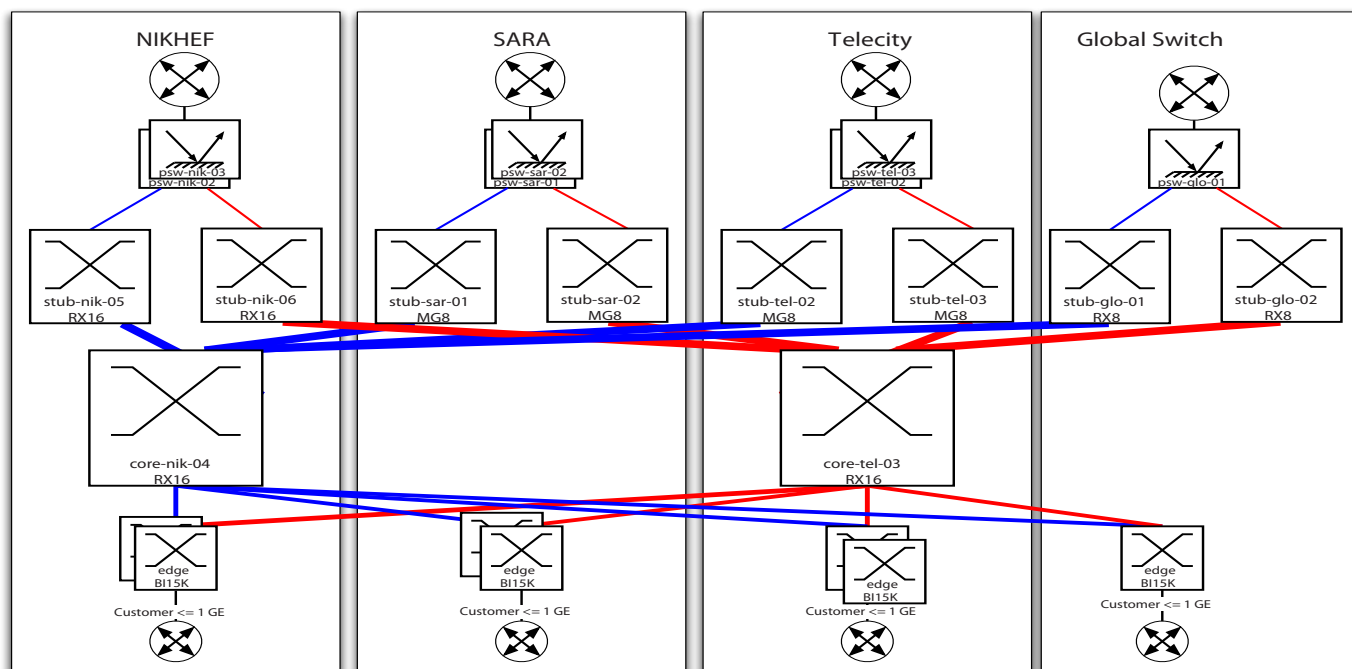


Figure 7. Topology of the AMS-IX, the largest Internet Exchange in the world.

Internet and Cultures. A world of difference. Today, there is not a single engineer or physicist on the board of KPN Telecom. There is not a single research activity in the same company, their once first class research laboratories have been sold. Directors have gained their experience in selling coffee and mars bars. And the same holds for the 'other' major phone companies in the Netherlands. Who owns Versatel today? Or is it Versatel that owns Tele2? Watch the stock tickers of your choice.

Google employs over 7000 researchers who passed a tough exam. Once employed, they are supposed to spend 20% of their time on non-Google, private, research projects. A wealth of computer science. A world of difference in a cultural sense. And yes, they do GRID computing and networking on a scale that goes far beyond LHC efforts.

Akamai, founded by two students, is competing on a grand scale with Google in the field of GRID computing and networking. They started out of MIT when over a coffee Sir Tim Berners-Lee made the flippant remark: "I can find the data - if only somebody could store it somewhere". Next, these two students took him up on his word and designed the largest data store on the Internet today. Akamai delivers your data from around the corner - and you don't know it. Whenever Bill Gates decides that you need new updates on your old Microsoft systems (if you are still using that expired technology) you probably don't know that it is coming from some room inside NIKHEF.

Nokia will sell you a mobile phone that can make phone calls. That is rather unique nowadays. A modern phone will drive your car, and your coffee machine, and your dish washer, and make por-

ridge. It will also do your banking, read your fingerprints for our American paranoia friends, and park your car. And of course, it has a fantastic 3D display without funny glasses as in the SARA CAVE. And the Toshiba phone will transmit your favorite fragrances. And the Mitsubishi one will transmit emotions as well. And Toshiba has phones that are better than your photo camera (10 Mpx) and better than your video stuff. Live streaming from your phone at 100 Mb/s to a wall mounted display half way across the world.

Question from an elderly gentleman from a classical European Phone Company:

"How do you do all this, what are the protocols?"

Answer from the Chinese gentleman:

"We use only one protocol: IP"

That is the Internet for you.

A whole different culture.



A rack full of GRID computers.