Frode Greisen interview

Born in 1940 in Copenhagen

About childhood:

My childhood was normal I think. My father was a businessman. And I was the second child. I had a lot of siblings, since my mother was the mother of six children. I liked going to school, I was happy to learn. I liked to play with my older brother, to run in garden, to build sand castles, and I read a lot. My parents had a library and I took from the shelves. 9-10 years old I liked books about kings and heroes, and 12 years old I started to read English books. I read lots of classic books.

My first experience with computers

I started to study engineering at Technical University of Denmark. In my final assignment I used computers. This was in solid state physics, and I solved the Schrodinger equation numerically. I learned a programming language called ALGOL. And this was running on one of the five or six computers existing in Denmark at that time. It was in 1963 that I wrote my first programmes. I graduated in `64. I stayed at the university for a PhD degree doing more or less the same thing. But my student investigation was on a fictive two dimensional crystal. Now in my PhD study I programmed to solve the equation for aluminium in three dimensions. And thus I learned a lot about electrons in aluminium at that time. There were not many computers, but there was a computer center which had the biggest computer at the time. And I ran FORTRAN on this computer. I used a little bit of telecommunications because I got a terminal in my office connected to the computer on the campus. But the connection was quite slow. I think it was 120 bytes per second. Not much.

So you've read a lot of books. How did you turn your interests into Engineer?

Well, when I finished my college I was 17. I had to decide what to study. And I was actually interested in mathematics and philosophy and theology, but my grandfather was an engineer and I understood that engineers also use mathematics, and when you become an engineer, there are many jobs you can have. So I decided, Okay I'll been engineer. But I was mostly interested in theory and my thesis was also actually in physics. This was at a time when atomic physics was new, you know, and we were beginning to have nuclear power. As it turned out there wasn't anyone building nuclear power plants in Denmark. After I finished my PhD degree, I was working as an assistant professor for a year or two. I also had a postdoc assignment in Bristol, England with some of the famous solid-state physicist at the time. But I found out that these people had another mindset. Then I decided that I'm not going to be a scientist. So I got a job with IBM as a computer salesman, because I'd already been working with computers. I worked with IBM for 7 years. And when I was around 37 or something, I got a job the same University Computer Centre I had been using in my scientific work. This new job was about computers, but now again it was about the use of computers, not selling them. And at that time, we now talk about 1978 or 1980, people were beginning to connect computers, first connecting terminals to computers, but also connecting computers to computers. So I also worked with computer networks. In `83 my career was stalled because of new managemnt and I just stayed at the same level - we called it to be sent out in a loop. But now I got time to work a bit more with computer networks, including a joint European project called EARN. We used the same IBM based technology as bitnet in the United States, which you may have heard about. So this was an

international computer network, eventually we connected to about 20 countries, and I had the honour to become President of EARN in 1989. But I still recall when in February `85 or so, I had my first e-mail conversation with fellow down in Germany. I had a green screen on my desk and this fellow had the same thing. I wrote him and he answered immediately. I was very impressed and I understood that fax and paper letters would go away. E-mail was clearly so strong an application that it would take over. It took some time, of course. Eventually we moved EARN from the IBM protocols to the Internet. We changed international telecommunication links to Internet technology.

In `89 I joined a workshop organised by an American professor called Larry Landweber. He had run a number of workshops over the years, but now, down in Sydney, he suggested that the next time it would not be by invitation, it was going to be an open conference. Landweber insisted that the conference should not be held in the United States, because the Internet should not be seen as U.S. system. He suggested we do it in Europe and I agreed to organise it in Copenhagen. I became part of the organising committee and in charge of the local organisation for the event 18 months later called iNET`91. At iNET'91 the Internet Society was announced. The next conference was in Kobe in Japan and next again in the United States. We continued with this annual conferences over the years.

Now, as I said, in the early `90s, we changed the EARN network into Internet technology. `92 we started a partnership to build further international Internet connections which we called EBONE, European Backbone. I came to manage this partnership. Later I took leave of absence from my job at the computer centre and worked full time for EBONE. At that time international telecommunication links were mostly provided by the incumbent telcos, the former national monopolies, but competition was being introduced by European Union. So eventually we were able to get international lines from their competitors at higher speed and lower price. We started out with 256 kbits per second. A quarter of a Mbps for the backbone. We had nodes in the Munich, Stockholm, Paris, Geneva, London, and Vienna. As I said we started in `92 which 256 kbps, and in 2001 we had moved up to 10 Gb per second. It's not impressive today, but at the time it was a huge improvement.

I was also involved with some other Internet organisations. I was in the Board of RIPE NCC which is the body that coordinates the Internet addresses in Europe. And I was in the board of the Internet Society. I joined the founding board of PIR, which manages the .ORG domain. But in 2006 I stopped working. I was 65 at the time. Since then I've only been an Internet user and otherwise lived in the analog world.

If you want me to talk about what I see as the good things with the Internet we can start with international communication. Maybe the most dramatic thing that happened was in 1989 when the Berlin Wall fell. Until that time, we were not allowed to build computer networks between Western Europe and Eastern Europe. But soon after the Wall fell we got a go ahead from the US Department of Commerce, and three months later we had a connection from Warsaw to Copenhagen. Quite quickly after that we also connected Czechoslovakia, Hungry, Russia and most of Eastern Europe to EARN and eventually to the Internet. It was a great day when scientists were able to exchange emails between Eastern Europe and Western Europe. And I think email has been of lasting value, in spite of spam (I receive about 100 every day). And by the way, when I got the mail from you with a Chinese token in the header, I first thought it was spam, since I don't recall any acquaintants in China. But I looked looked at it, and I'm glad that I came to talk to you and be part of the project.

And of course, the world wide web is a fine invention. But I have to say that my dream for the Internet, shared by many, I think, was that we were building an infrastructure for both one to one communication and many to many communication. In reality mass communication, one to millions, also uses the Internet.

One of the most amazing things on the Internet in my view is Wikipedia. Wikipedia is built by volunteers, based on the common human urge to show what you can do and to tell people what you know. I think that tests have shown that Wikipedia has fewer errors than Encyclopedia Britannica. I mostly use Wikipedia for my own field mathematics and physics and I find the articles excellent.

What I'm not so impressed about is that the Internet used for advertisments and marketing. For me, that is just noise.

Other thing I'm reluctant about is Surveillance. You know, George Orwell wrote a book in 1949 called 1984. And in this book Big Brother sees everything, hears everything, tells you which words to use. The book describes a nightmare. But today there is a lot of surveillance over the Internet, probably much more that Orwell had imagined. Many people think that privacy and personal freedom are very important, but these rights are violated by private companies and governments. Many governments say that they do surveillance because they want to avoid terrorists. Well, yes, yes, maybe. But I mean, I think we should tolerate the small risk of violence and only make surveillance in specific cases, in cases where there is an indication that specific person or group is about to do something. Then you can start surveillance and monitor the suspected persons. Not everyone. When I walk around with my smartphone my government and NSA knows where I am all the time. And I think this is wrong.

Can you tell us more about EARN?

European academic and research network. This was an association with country membership. In Denmark, my organisation was a member, we had telecommunication links between the universities, so that they could do email and file transfer. It was the same as BITNET in the United States, and the two networks were connnected. The EARN network was started in `83. Denmark was connected in `84 and I joined the board in `85, I think, something like that. I was a user from `84. But it was not built on the Internet Protocols, although it provided some of the services provided by the Internet today. But there was no world wide web.

During the first years we connected most of Western Europe. In 1989 the iron curtain fell, and as I said, three months after we got Poland, Czechoslovakia and Hungary connected to the Internet. We were tried to connect to Yugoslavia, the corner of the Soviet world, but it didn't quite work in the `90s because of the Balkan wars. I remember I met a Yugoslavian colleague who said in five years, there will only be six European countries: The European Union, Serbia, Slovenia,Croatia, Bosnia, Herzegovina and Dalmatia.

Did you need to convince someone to build network after the wall fell?

Yes. Well, you know, we had telephone connections between East and Western Europe. We also had meetings where we talked about computer networks. I've been in Eastern Berlin and in Hungry for meetings in the eighties where we discussed these things, so we knew each other, and of course there was scientific collaboration. In my early days in the `70s there were also Russian scientists working in Denmark. One of my new EARN board colleagues in the Czech Republic had also been a visiting scientists in

Copenhagen. It was clear that there was a need for telecommuniction. There was a country collaboration group called Cocom, the Coordinating Committee, where western countries had decided not to export technology that could used for building weapons to certain other countries. So during the Cold War there were restrictions on computer export and restrictions on who could use the most modern computers via computer networks. I had discussions with a man in the Department of Commerce in United States and initially he said, OK, maybe we could have networks if all communication was in English so that intelligence agencies could read and control the communication. This would be hard to establish and did not happen. But when the Wall fell, there was more confidence between the two blocks, and we were allowed to have the telecommunication connections. In addition to the scientific cooperation, we felt that it was fantastic that normal citizens in all countries could now email with each other. Citizens in Poland could now have correspondence with their family that had immigrated to United States, and tell each other about how their life was.

In Warsaw the man I coordinated the connection with was the physicist who also worked at CERN in Geneva, and he was eager to connect his university to CERN as soon as it was allowed, and therefore it happened very quickly. This was, of course, initially was used by scientists and was only for science and education. The Internet today is for everybody.

Were there any countries that were not willing to be connected, especially may be rejected by the government?

Let me think. Well, we had an application from Iran to join EARN. And I think we thought okay, why not? But they did not connect. We also talked to talked to Syria, Tunisia, Algeria, and we told these countries that they could connect to us. The principle was that every country joining must provide a connection link to a country in the existing network, so we recommended Syria order a link to Rome, but they never did. But Turkey joined , and both Turkey and Greece were members of EARN.

How did you convince the government? Like Iran to allow their country to be connected.

Well, we did not prevent the connection. We said OK, you're welcome to connect. We go in for free communication. But they never joined. I didn't get the reason, but I heard rumours that their government would not tolerate the risk giving their citizens access to sexually explicit contents. Today I'm sure they have Internet connections, but this came after my time with EARN.

Do you still remember totally how many countries connected to EARN?

I can look it up, but I think it was 20 or 25. This was only in Europe, but we were connected to BITNET in the US. They had connections to countries in Latin America and Asia, so the total was 50 countries.

What was the relationship between EARN and EBONE?

The story is that I was President of EARN, and I was also coordinating managing EBONE. And we decided in EARN that we would not continue with the IBM based EARN technology. At first we ran a project to build and OSI system in Amsterdam, but we abandoned the idea to install such systems in all countries. We decided to move to TCP/IP. And then we changed the switches and routers at each end of the links and made them part of EBONE. People used different routers, for instance, in Russia they

ran TCP/IP on a PC. The router function was done with the PC.

We then made a merger between the EARN Association and another association in Europe called RARE. This way the EARN project was terminated. Because it was taken over by Internet. We can say that the technology was obsolete, and the strategic choice was to move to TCP/IP. The Internet was built by technicians with IETF, they define the protocols and then people build their networks to use a protocol. So TCP/IP won everywhere. And OSI was abandoned. A lot of money was used to get OSI working. OSI was built top-down and TCP/IP was built bottom up. There was also a discussion whether we should we have an intelligent network or stupid network? The choice was a stupid network. Incumbent telecoms were developing intelligent networks, such as ATM (Asyncroneous Transfer Mode). But this road was abandoned.

Did you encounter some power or force for you give up TCP/IP?

There was a pressure in many European countries, and in the US, that we should choose OSI, not TCP/IP. There was a large project in the European Union called COSINE to build OSI, and public procurement rules in many countries that systems should be OSI-ready. And the EU used 40 million euros on COSINE. They build a few OSI nodes and maybe transmitted about 200 emails in five years, which of course was pretty ridiculous. But it was not forbidden to use TCP/IP. It was just that you couldn't easily get government funding. EBONE was funded by some of the European research network organisations as well as private companies. So it wasn't entirely forbidden. There were members from the telecommunication companies, phone companies were also joining so build it, so it was part academic and part private commercial.

So TCP/IP was not forbidden to use in Europe. But if you use it, were there any pressure or punishments?

No, no. That’s not the way it works. It was just that you could not always easily get funding. If a company or university wanted to use the TCP/IP then they used TCP/IP.

It was just not easy to get funding from government. If you had the money, you built what you liked.

Europe had an ambition, and we still have, to be a world power in in certain industries, to be a technology leader. We tried to do that in computer networks, but that didn't quite succeed. Now we try other things.

Can you tell us more about why TCP/IP won over OSI?

I already said that the question is bottom-up versus top-down. Some of the implementations of OSI were circuit switching. Like the old telephone system, you get a copper wire connect between the two phones. Now package switching was invented in the sixtees or seventies, and today it is clear that in Telecommunication, package switching dominates. Some people have compared it to shipping. In the old days, you have special ships for coal, other ships for oil, other ships for woods, other ships for small goods, today we just have container ships (and tankers). What is in these containers doesn`t matter, it`s just a container you move. Package switching works the same way, it contains a data package, maybe it`s video, maybe it`s audio, maybe text, maybe it`s music, we don't know. We just ship the packets and move them, and that has proved to be the best protocol for multimedia and modern communication.

So you mean TCP/IP won because of packet switching?

I think you could also do package switching with OSI, but some of the early implementations in Europe were circuit switching. Many of the concepts in OSI are probably OK. In some countries you drive in the right side of the road and the other countries you drive in the left side of the road, it`s not the matter of which one is better, but everybody in a country must drive in the same side of the road. Then you build the cars for that, one for left hand drive one for right hand drive. The Internet is global, so use TCP/IP and forget about OSI.

PTTs had a monopoly on public communication until around 1990. Yet there were computer networks, private computer networks within international companies. For instance in IBM, where I worked in the 70s, they had internal network where they could send email to each others, and process orders and deliveries but only within the company. To do something else was illegal at the time, it was only PTT business. And international links were supposed to be used for international telephone calls, not for international data communication. And in the telephony world they charge minutes, you paid for how many minutes you used telephone. In data communication world, you charge for bandwidth, and eventually alternatively for volume. When we got a connection to EARN between Denmark and Germany, we had to say that it was nearly private, it was just between universities. They accepted this, but then asked us to pay a fixed charge plus a volume charge. Well, of course we had to pay monthly fee on the link, but initially they also wanted us to measure how much data was transferred, they would then translate that volume into voice minutes which we should also pay for. It was quite stupid. We were able to convince them that we just had to pay a monthly fee. But high speed international links were hard to get. At some time in the EBONE wanted to upgrade a link between Amsterdam and Paris from 256 kb per second to two megabit per second. But then the French PTT said “This is not a product that we offer. We don't do that thing.” But at that time, competition was allowed to get in. And there was a company called Hermes Europe Railtel, a joint venture between the railway companies. Because what railway companies have is rail, and they can pull fibre along the rail. Very easily. So they started to offer Telecommunication lines. So we got a 2 megabit connection from the Railtel company instead of the PTT. Eventually of course, PTTs found out they had to offer hight speed links, and then they did it.

So it's kind of like the PTTs were forced to accept the new business.

Yes, PTTs were against new stuff, of course. I know that within the PTTs there were many who knew about Internet technology. But if a big company wants to do something, then the engineer has to convince his boss this is very good thing. The boss has to convince his boss this is a good project and so on. So takes two year to do something new. When the Internet came rolling, the PTTs were not ready. Now they saw that this was serious, so they both tried to build Internet services and to buy Internet society providers. In EBONE, we had all Incumbent European PTTs as customers (although not all at the same time). Deutsche Telekom was a customer to EBONE for European backbone connection, Swedish Telecom and two Swiss phone companies, French Telecom, Italian Telecom, they were all customers of EBONE, because their business had only been to charge minutes to each other’s international phone calls. They could not find out how to do a common International data network. In spring `95 or something, there was an Italian lady in a fur who came up and visited me in Copenhagen and asked what about this EBONE stuff, can we get connected to EBONE? And I said yes, gave her a two pages contract, and suggested she go home and have it signed. They signed it and bought EBONE connectivity until they could build their own

Mediterranean network - I'm not sure whether they succeded. They also had direct connections to the US, which was the centre of the Internet, of course. But they realised that if they wanted to spend data from Italy to France, it was kind of stupid to send it via United States. So that became via EBONE for a time. Then, of course, the PTTs understood than the Internet was serious, and they built their own networks and other companies built their own networks.

What next happened to EBONE was that EBONE was sold in `99 to Hermes Europe Railtel, who had the basic data links. Railtel was then sold to GTS. And in 2002, GTS was sold to KPNQwest. KPN was Dutch telecom operator and Qwest was a US phone company. And then KPNQwest went bankrupt in 2003. But that was after I had quit, so I didn't mind.

Can you tell us more about the establishment of EBONE?

Okay. In `91, country Internet worked. There were a lot of international links, like EARN links and there were links between CERN in Geneva, High Energy Physics Centres and various other centres. There was a Swede who collected information and counted all the links, which were mostly 64 Kb per second. There were 20 or 25 of them or something like that. We talked about it and decided that we must be able to do it in a better way. We must set up a new system. We had EARN but that was a wrong technology. Kees Neggers in the Netherlands had a memorandum understanding worked out, and had a number of research networks and telecommunications companies sign it as members of the Ebone consortium. Some members bought a link and I checked what the link rental was and what bandwidth each memeber was connected with. Then we shared the cost according to bandwidth and that was the way we worked EBONE initially. We changed the consortium into an association which set up an operational a company in `96 or something. So it was a joint venture initially.

Is it ok to say that EARN used IBM protocol and EBONE used TCP/IP?

Yes.

When did EBONE transfer from academic network to a public network?

We did that from the start with EBONE, while EARN was a university and research system. In the early EBONE times, we had members. We had IBM as member, we had Swedish Telecoms as some of the very first ones. So we said OK, this system will take everybody in if they want to pay for bandwidth. The universities were the early users of computer networks, but then of course, especially after the world wide web came up, everybody went on the Internet. So we decided open EBONE to everybody. A Commission funded research network only for researchers and universities called Dante was established.

When did EBONE commercialize?

EBONE was commercial from the start. We started commercial. We did not want to make money for the company, we just wanted to share the cost, it was open to all users. And all customers also to became members.

How did you charge it?

Tele2 buys a link from Stockholm to Amsterdam, CERN buys a link from Amsterdam to Geneva etc. and they give me the cost. So I calculate the annual cost of everything, right? And then I see that Tele2 has pipe of 525 kb per second. In Holland, SURFNET

has a pipe of one megabit per second etc.. Here is the bandwidth, here are the pipes, so here's the cost per Mbps. We share the cost according to use. Tele2 who has paid for line and made it, get some money back and others who didn`t pay the line, they paid it. So it was a cost sharing initially.

So it's only to cover the cost, not to make profit.

Yes, yes.

You were Board member of the Internet Society.

Internet Society was established by Vint Cerf and Bob Kahn. This is the society where we are going to talk about the Internet, we are going to meet, we're going to exchange information. And eventually also want to provide support for the standards work of the IETF. So we said OK, we will help expand the Internet. And the first conference, many came to learn how build an Internet, and others came to explain how. Eventually ISOC also got chapters, so in addition to the annual INET conference, there would be meetings in China or wherever for people working with Internet technology. So they could help each other to build the net.

So how did you build Internet Society from nothing?

Well, as I said, Vint Cerf announced it in `91. Then there was an e-mail conversation about who was going to be in the board. We were 12 or 15 of us on the founding board. We had some meetings, physical and via the phone. We discussed what we were going to do and who we were going to work with. It was a forum for discussing how to expand the Internet, and we also It was new at the time, we were also talking to governments and provided information and help people to bring the message that the Internet is a good thing.

How did you expand the Internet and convince governments that it is a good thing?

Let me give personal recollection. I had an old schoolmate who was a government minister in Denmark. She called me and asked for some advice about this Internet thing? And I told her not to touch it. After the OSI mistake, I did not think governments should interfere. Governments should not fund Internet developments or steer it in special directions. Of course, there had been countries where the government was not be interested in having international communication. I mentioned Iran. I don't know the details, but some countries want to check international data flows, and it's no secret that China has a policy about this. Our opinion in this matter was, and still is, that the Internet facilitates communication just like the telephone, and people want it. It's a good thing for humanity. People like it.

In the early days, the Internet was organised in the United States. Originally there were five general top level domains: .com, .org, .edu, .mil, .net, but soon national top level domains became useful. There was a decision pretty soon to use the ISO two letter country codes like US for the United States of America, CH for China, DK for Denmark.

Then, if somebody wanted to manage the Internet domain names in Denmark he or she sent email to Jon Postel who was at IANA in California at the time. He or she explained name, affiliation and experience, and then, after a bit of conversation, got the responsibility to allocate unique domain names to people who wanted one. The

allocation of domains under the five generic top level domains were managed by an American organization called NSI. But then in 1997 or something the National Science Foundation, United States decided that this is too big for NSI and made a public tender for managing these domains. because it could become big business. A working group within ISOC made a bid for the .org domain. They won the tender and I got into the board of the non-profit company set up for this, called the Public Internet Registry (PIR) around 2000. So we bought computers, hired some people and established the business. I was only in the board for two or three years but PIR became a quite stable money machine - like many other parts of the Internet. This income helped the mission of ISOC. Since NSF relinquished control of the unique Internet resources, ICANN is taking care of existing and new domain names. There are some weird domain names, I never understood the need for them, but there's a lot of money in this business.