Peter Kirstein CBE

Interviewed by

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At his home in London

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Welcome to the Archives of Information Technology. It's the 28th of March 2019. I am Elisabetta Mori, an interviewer with Archives of IT. Today I'll be talking to Peter Kirstein. We are in London, at Peter's house in East Finchley.

[00:19]

Peter Thomas Kirstein is a British computer scientist. He is often recognised as the father of the European Internet. Professor of Computer Communications Systems at UCL in London. He has been appointed Commander of the British Empire in 2003. He is a Fellow of the Royal Academy of Engineering, a distinguished Fellow of the British Computer Society, a Fellow of the Institution of Engineering and Technology, a Fellow of the Institute of Physics. In 2003 he was awarded the Postel Award by the Internet Society, and in 2006 he was given the Lifetime Achievement Award of the Royal Academy of Engineering. In 2012 he was inducted into the Internet Hall of Fame as a pioneer by the Internet Society, and in 2015 he received the prestigious Marconi Award. He received the Senior Award of the IEEE Computer Communications Society. He was elected to the US Academy of Engineering, and the American Academy of Arts and Science.

[01:25]

Welcome Peter. We can start with, where and when were you born?

Well, I was born in 1933, and I was born in Germany, in Berlin. I almost wasn't born in Berlin, because, of course, this was just after Hitler came to power, and, my father had actually been member of a very prestigious yachting club in the late Twenties, early Thirties, and when in 1931 the secretary of the club said, came to him and said, 'Surely you are not feeling comfortable in this club, with people like Ribbentrop and Goering as members of the club?' they didn't know what he meant. He didn't understand it at all, because, he had been in the Germany army, he was a very patriotic German. Just didn't know what they meant. Then they understood. They regarded him as Jew, and he was completely assimilated. So, this was a great shock to him. So, as early as that, when my mother became pregnant with me, they considered having me born outside Germany, but in fact, in the end I was born in Berlin, and lived there for the first three and a half years of my life.

[02:48]

So you were born in 19…

'33. June '33.

And do you have any vague memory of that time?

Very very vague. I sort of, vaguely remember my father, being in a yacht with him, and the yacht going aground, and people climbing onto the mast of the yacht in order to get it off where it was stuck. It's isolated things like that. I do vaguely remember, and I have been told about it since, that, when we actually moved from Berlin to Britain, my father was a little, somewhat harassed, seeing all these officials, and suddenly his three-year-old son had disappeared. And, I was standing in front of a bobby, big bobby, with my thumb in my mouth. What had happened was, my father had said, 'It's all right your sucking your thumb in Germany, but in Britain, there is a big policeman, and they have scissors to cut off your thumb.' So very early on I decided to do the experimental approach, and stood in front of him, and asking him in German, 'Where are your scissors to cut off my thumb?' With of course my thumb in my mouth. Perhaps that's fairly typical of what I did later. But the other thing which I should say about that, my mother happened to be born in Britain during, at the turn of the century, and so, when my parents wanted to move away from Germany, they suddenly discovered that she was a British citizen. She didn't know this herself until 1935. So she could move very easily to Britain. And therefore, it was much easier for us to come. And that was a time when it was not easy for Germans to come to Britain.

[04:54]
So, can you describe your parents, what were their occupations?

Both my parents were dentists. My father had been very patriotic in the First World War. He volunteered at seventeen, nearly eighteen, in the First War, in the Medical Corps; then he was in the Field Artillery; and, he got the Iron Cross even. So that's why he felt he was a typical German, not anything else. And of course those Jews were completely assimilated. In fact he was secretary of his fraternity, fought duels for them. Not very…. He… Later he couldn't understand how he could have fought duels, after he had just lived through four years of the First World War, but that was

life at the time. And, then, he studied dentistry. As a veteran one had, had a rather shortened course. So when he later wanted to come to Britain, he suddenly discovered he would have to study again, to get a little more. He did something which for 1936 was impossible for somebody who Hitler regarded as Jewish. He managed to enrol again at the University of Berlin for another six months, because one of his patients was Bormann's mistress, and having got the Iron Cross he persuaded the president of the university to let him register again.

[06:44]

My mother was, had many talents. She originally wanted to be an artist. She then started going out with a medical student, so she studied medicine. She then met my father and decided to study dentistry. And, she was a dentist throughout her life. They were always very keen skiers. My father started that in 1908, when he was about twelve. And, in those days of course, it was mainly ski touring. One didn't have the sort of piste skiing. They were very keen, he was a very keen sportsman, both tennis, squash – not squash, tennis and yachting, but of course when they came to Britain they had no money at all so many of those things went by the board, until after the Second World War.

[07:38]

You came to London in 1937, and, what was your family life like in the beginning?

Well, first of all one didn't remember it very well. I was only three and a half.

Yes.

But one learnt of course English very very young, immediately. It's very easy for a three-year-old. On the other hand, we were lucky from another point of view, and that is, there had been, one of the servants one had in Germany… Of course, in those days it was quite common to have four or five servants, as a middle-class professional, and one of them had gone to my great-aunt in 1917, then gone to my grandmother in 1919, and went on as a wedding present to my parents. So, by 1937 she had been with the family for 20 years, and so when we were going to come to Britain, she said she was going to come too. And, my parents of course said they couldn't possibly afford to pay her anything, they had no money at all. She said, 'It

doesn't matter. I'll come.' So, she stayed, and she lived with us until she died in the early Sixties. And as a result, since she never learnt English properly, I always spoke German. And, my German was not a very good German, but it was a very fluent German, up to, say, a six-year-old. And it's just as well, because my parents stopped talking German in the Second World War, completely. But I could keep it up because I had to, to talk to Martha.

[09:26]

Which schools, colleges and universities did you attend?

Well, I went to a primary school, which hardly counts. I was evacuated three times, and each of the times I was of course at some sort of school when I was evacuated. Again, I don't remember if I learnt anything particularly academically in those times, but by the time we came back to London from the, certainly the second evacuation, was the end of 1941, and I then went to Highgate School. At that stage, it was very small, because most of them were evacuated, but, but I stayed in that school until the end of my school career some nine years later. I… The way the British university system worked is, one did one's scholarship exams if one was going to go to Cambridge, as I was, in November. One knew in December whether one was accepted, and, you could either go straight into the Army, because there was conscription, or, you could defer your going to the Army, and in that case you had nine months to do anything you liked. Because you couldn't go till October.
[10:49]
At that stage my uncle and aunt in California had promised me that if I got a scholarship to Cambridge, then I could come to California. So I spent six months in Los Angeles. I went to UCLA, University of California in Los Angeles, for six months.

Your relatives helped you to get in UCLA?

I got to UCLA just on my, record. But lived with them.

Yes.

I lived with them. And, what was important about that was that, they were analysts, Jungian analysts, and in those days Jungian analysts met, mingled a lot with their patients. And, although I was a rather precocious but innocent seventeen-year-old, I was allowed to attend some of the psychological lectures. And there I always asked some questions, and a professor, who was one of the patients, thought I could, dreamt that I helped him in his work. Now, somebody like me was not allowed to work as a foreigner in the US, but he had a project with the US Army Engineers. He said that he would try to get me a work permit, and he did. So I worked for about four months with the US Army Engineers at seventeen and a half. And that made all the difference, because, suddenly, instead of asking one's uncle for every penny one wanted, one was actually earning a very good wage, which completely changed my view on America. I then went back to Cambridge, and started at Cambridge, in mathematics. And the following summer, one always takes summer jobs of course, I wrote to my previous boss and said, 'Is my job in California still open?' Well those were not days when one travelled the way one does now. So I went back and took that job for another three months, in the summer.

[13:00]

Have you got any special memory of those months?

Oh absolutely. It was… First of all, from the beginning already, it was a complete revelation. One always has one's pin-ups of actors and actresses, and this was in the middle of the McCarthy era, and many of these patients would know that they were going to be asked to testify before the House Un-American Activities any day now, any week now, and once they did that, they would either have to denounce their friends, or, they would lose their jobs and be announced as communists. So, you suddenly found these people, actors, actresses, directors, songwriters, who I would look up to as heroes, frightened. And that was an incredible picture. The impression it made was very very strong.

What was your favourite pin-up?

Actually I liked Märta Torén very much at that stage, because she, she was one of those who came to dinner.

Really?

The other thing which I remember very vividly was, Nixon was running for President in 1952, and he was accused of having taken bribes. And he gave a talk in which he answered nothing, but said. 'There is one thing I will never give up, and that is my dog Trixie.' And, it was a very bad talk, in the fact he didn't answer any of the questions, but, half the people I talked to afterwards said it was a very, it was a very good talk, he obviously answered everything, and the other half said it was a very, it was a bad talk. But all the rest of them would think it was a good talk. And the fact that one could so much influence things on television, was something I have never forgotten.

[15:20]

So then I went to Cambridge, did mathematics for two years. At that stage, I was entitled to a degree but I had to stay for a third year. I considered going into the Computer Laboratory, I considered going and doing Part III Mathematics, and I considered going to Electrical Engineering Part II. Luckily I decided on the third one. I felt that the Computer Laboratory was going to be rather narrow. Little did I know what computers were going to do.

[15:53]

So did you see the EDSAC?

Oh yes, of course I saw the EDSAC. Yes. In fact, not only did I see the EDSAC, when I was talking to Maurice Wilkes at the time, to decide whether I was going to go there or not, one of the people who came in to talk to him was Hartree, who was a very famous applied mathematician there, and he was trying to persuade me to go to the Computer Laboratory, and he was talking about the applications of computers, which was something I hadn't thought about at all. He said, 'For instance, we're building… We're designing this aircraft, and one of the things which is happening with it is, they're not using computers enough. I think we should be doing much more about the stress in the aircraft. And, we're not doing that.' And of course, about a year later the Comet started coming to pieces, because, the windows were square rather than round, and they hadn't done the stress analysis by computer at the time.

And so he was shown to be completely right. And that completely ruined the whole Comet programme. So yes, I saw EDSAC at that stage.

So was the EDSAC the first computer you saw?

Yes. And, there was a huge contrast. The EDSAC did have a respectable few thousand words of storage. When I went to Stanford at the end, which was in 1954, there my first computer was very big. It had nineteen words of store. The IBM 605.
[17:28]
So, what happened then, I went, I decided to go to electrical engineering. And that was very fortunate, because the head of electrical engineering at Stanford was doing a sabbatical at Cambridge, and he offered a fellowship to one student in electrical engineering. And I wanted to go, and so he offered it to me. And, so I started at Stanford in 1954, and stayed there till the end of my PhD, there.

[18:03]
And what was your dissertation about?

It was called 'A Solution to the Equations of Space-Charge Flow by the Method of the Separation of Variables'. It was taking some fairly complex Maxwell's equations with space charge. That was nothing to do with computers. And finding an exact solution for them, from which one could build electron guns. And for the first few years of my research life I was actually interested in a space charge flow, and eventually wrote a book with some co-authors on that area. But, at the end of my PhD I decided, I had worked quite hard at studies, it was time I had some relaxation. So I should go to somewhere where one could ski more seriously, and the best place was to go to CERN. [both laugh] So, although I could…

That was in 1959.

No, that was in 1954.

OK.

Fifty… No, '58. '57, '58. I got my PhD… I finished my thesis in '57, and spent another year as a lecturer at Stanford. At the end of '58, January '59, I went to CERN. And…

[19:27]

When did you meet your future wife?

Well, I was… I met her on a boat. I did… I started a thesis in, so working on a project for my thesis, in 1955. Although I had passed my university orals based on that, I didn't really enjoy doing it. So I decided I was fed up, and would go back and spend three months in Britain. And so in September '56, I was on a boat coming from New York to London, and there there was a girl who was busy flirting with all the boys, and I decided it was just the sort of girl I'd keep away from on the boat. But I didn't. And, we got to know each other quite well there. I didn't see much of her in London, because she was living in Nottingham and I was in London for a few months, but she came down to London a few weeks before, one week, or two weeks before I was leaving, and we got on quite well. And, then I went back to Stanford. And then, probably nine months later, something like that, I was, I had finished my thesis more or less, was job interviewing on the East Coast from, and decided to go through Chicago where she had gone back to. And, again, we got on well. So I invited her to come out to California, and she came. And, six months later we got married. [laughs]

Did you have any children?

Yes, we have two girls. One is now fairly senior in pension law, she's in charge of pension litigation for British Telecom. One, didn't have a particular career for a while, but now she is doing a lot with project management in churches actually, in the commercialisation of church activities.

[21:36]

And we are talking about your moving to Geneva and to work for CERN. Can you tell us more about that experience?

Yes. I was with a very small accelerator research group. It was working on a new form at that stage of accelerators; a rather classical form had just been, was being built. And then, what one wanted for the future was to have storage rings, and so this was a research project in looking at the storage rings. It was quite successful, and eventually it became the things which are now the storage rings that are the injections for the current large, HC, Large Hadron Collider. But at that stage, this was a very small one. I was responsible for the injection system because of my earlier activities in space charge flow, and there I was responsible for, in the end, for an accelerator we were buying from the US. Had to do acceptance tests. And so I started going to the US for that reason.

[22:52]
And what was your life like at CERN? Did you manage to ski?

Of course. In CERN one had six weeks' vacation, and, also, a very nice salary, tax free, for the time. So, yes, we always went for two or three weeks at Christmas, or, and then, always go for weekends whenever one wanted to, and if there was snow in the Jura, where one would go for lunch to the Jura. And somehow or other one would be telephoned back and saying, 'Sorry, we have some very important business engagements,' we couldn't come back in the afternoon. So, yes, one skied quite a lot.

[23:36]
What about your experience in the Soviet Union?

Well, what happened there was that, CERN, fairly early on, had a, one of the first exchanges with an equivalent accelerator research lab in Dubna, the Joint Institute for Nuclear Research. That had something which they called the equivalent of CERN. Where CERN was European countries collaborating together, the one in Dubna was the Soviet, the satellite countries, like Czechoslovakia, Hungary, Poland, and also China, who also were there as… But of course the whole thing was, being Soviet, was completely Soviet-dominated, so that the directors of all the laboratories were Russian, or Soviet at least. There were two vice-directors who had no power, one in my time was from Romania and one from East Germany, and then the director again was Russian, or Soviet. Very hierarchical.

Which language did you communicate in?

Well, I had started learning a little Russian when I was in Geneva, but I learnt it through a French – a Russian who was an émigré, and she taught me in French – Russian. So, my Russian was very very elementary. And, when I first got to Dubna, my wife Gwen gave me a shopping list. That's the way one always did one's shopping in Geneva. So, I went with my shopping list to the one shop in Dubna, and, wanted to go, wanted to buy what was on the shopping list. I immediately discovered that's not the way you shop in Dubna. You first of all see what's in; you then go somewhere else in order to pay for what you want to have; and you then go back with the chits and get it.   Of course when you are paying, you first of all compare their charges with yours on the abacus they loan you, because, that was the way you could do your checks. And therefore, you either learnt enough Russian to go shopping, and ask for the things, or you starved. I didn't like the idea of starving, so I learnt Russian. [laughs] And, I even wrote some papers in Russian, and gave some talks in Russian. So, by the end I was reasonably good, which came very useful to me some forty years later when I did some work in Central Asia, in the Caucasus, which I presume we'll get to later.

[26:40]

Yes. So what year this year in Dubna?

That was in 1962. And that was under Khrushchev. It was a comparatively relaxed time there, but only comparatively. It was nine years since Stalin had died, and, people were worried, would anything like that happen again? So for instance, when I wanted to submit a paper to a conference in the West, for when I came back, I thought it would be best if it came from Dubna, and deliberately would be submitted on Dubna notepaper. So I asked the international department, would they write that letter? And they wrote it on plain paper. So I said, 'But it's got to be on official paper.' They were very hesitant, and three weeks later they gave me the same letter, again on plain paper. I said, 'Look, I'm only submitting it from Dubna this way because I thought it was good for international relations. If you can't do it on official notepaper, which is the way one always does, I'll use my CERN notepaper, which I

have.' 'You have CERN notepaper, which *you* can use?' They were absolutely appalled by the idea. There, no one had official notepaper. One asked the officials to write the letters for one. It was very very hierarchical. But, extremely interesting, the Russians were awfully nice. And, the only thing was, on the whole, one didn't meet many party people. It was only when was in hospital with dysentery that I spent about a week or two arguing politics all the time, which was superb for my Russian.

[28:54]

After your time in the Soviet Union, you moved back to Geneva., and then what happened?

Well first of all I moved back to Geneva, but, in fact, I must have been rather an object of suspicion in Dubna as well, because, every month or so I would telephone to, back to CERN, to ask, was my, the machine I was supposed to be accepting in Boston ready yet? So here was I, telephoning from Dubna to CERN to ask, should I go to the American, to the USA? Which was completely foreign to their whole concept. Well in fact, it wasn't ready till October for my acceptance tests. So I then went , and of course now my Russian was reasonably fluent. So when the Missile Crisis started in November 1962, and I was living in, just for a few, a few weeks, in Boston, for these tests, I would go every morning to Harvard Square and pick up either *Izvestia* or *Pravda* and take it in to the company. That didn't make me very popular [laughs] with the company I was visiting either, because, they did not expect to see a *Pravda* right in the middle of the Missile Crisis sitting, being read there. But still, it all went well.

[30:30]

So I came back to, after that, I had more or less, that project was going to end, and I would either stay for another project, which would be another five to seven years, or change. Well, I felt that CERN was a bit like a gilded cage, and, I didn't really want to stay another five to seven years, pleasant as it was. I already then considered looking for a position in the US; I considered a rather good job I was offered in London. But then, GE asked me, would I like to be a scientific representative for them in a small office with three people, living in Zurich, where the main thing they were requiring was a PhD in electrical engineering, a knowledge of the US way of life, and speaking French, German and English. Well there weren't that many people

fitting that, and it suited me perfectly. So I sat on a mountain in Zurich for the next four years.

What year was this?

That was '63 to '67. And again, I would have to, I would have to spend quite a bit of time in the States. So, every year I had to go two or three times back to the US. So, I got to know what was happening in the US pretty well, and my job was to see anything which was outside solid-state physics or chemistry which might be of interest to General Electric, anywhere where I liked in Europe. I went once to Russia again during that period, and once to Israel. But mainly it was in, all over Europe. And I could choose to go wherever I wanted, when I wanted. And, in the process, going to the US some of the times, my sister was by that time living in California, I would go again, usually to California, partly because GE had also bought a number of computer-related companies, and I had decided to be interested in computers and communications, I got to hear about this strange thing called the ARPA project, which was starting an ARPANET project. I heard about it first when I was visiting UCLA, and they were connecting together some computers back in 1966, and about the same time I went to, a bit earlier, '65 I think, I went to visit a, someone just finishing his PhD in graphics called Larry Roberts. So at that stage I also met, on the roof of the electrical engineering department of UCLA, somebody who again became very important to me, somebody called Vint Cerf. And I also had just about met somebody else when I went to Boston, called Bob Kahn. So, that all came out of those times in GE.

[34:01]
In those times GE in Europe in particular was trying to take over a little in the computer market. Because in 1964 GE bought Bull in France, bought the Olivetti computer department in Italy. So, were you involved in computers at the time?

Well, I could choose to do whatever I liked, which was of interest to General Electric, and was outside solid-state physics and chemistry. I had already, as part of, of what I was doing at CERN, made heavy use of computers as part of what I had been doing. So I had been a computer user. But as part of this, I decided, and GE certainly agreed

with me, that computers and communications were important to General Electric. So that, I got to know people at very senior levels, up to the group vice-president level, in GE, in the US, and for that matter in Bull and in Olivetti. So, yes, I became very knowledgeable about them. And, began to, became very strongly involved in liaison between Phoenix, Paris, Milan, and also Schenectady of course, because Schenectady also wanted to become involved with assisting them. So, my primary responsibility was to the research centre in Schenectady, but of course, if I had such good relations with the other parts, that was all for the good. Most of their research people didn't have such good relationships with the operating parts of the company. My life, most of the time, I was living in Zurich, I would spend a few weeks in Schenectady, then while there, after, say, spending two weeks in Schenectady itself, I would be visiting other parts of General Electric, all over the US. So, I got to know the whole business of General Electric very well. Because I didn't really fit in to the organisation itself, whereas if you really worked in the US, or for that matter in any other operational part, you had your place, and, you might see people one or two levels above you, and perhaps one or two levels below you, but that's all, the three of us who were in the Zurich office had no formal position in the hierarchy. And we went all the way from senior vice-presidents down to people working on particular projects. And therefore, one sort of drifted up and down the organisation, and nobody quite knew where to place you. And, in the weekends, we would, I would go to places like Lake George up there, and perhaps go skiing, or, water-skiing with the vice-president. On the other hand it might equally well be with somebody working on research projects. So you had a very fluid, and in Zurich things were very fluid too, because, as in Geneva, there is quite a big international group of people, although in Zurich I was also in the local tennis club, and even played for Witikon versus Canton Glarus. [laughs] So, it was a nice life.

[38:02]

But again, I decided that, if I had been 20 years older I might stay there. And in fact, one of my colleagues lived all his life in that particular job. I didn't know any other job I wanted in General Electric, so that, round about '65, '66, I decided I want to go to academia. I considered going to the US, was offered positions at Stanford and Berkeley, but in the end I decided that, Europe was closer to the US than the US was to Europe, so that, when, I considered something at Oxford, but when I saw a fairly senior position in London, I decided to apply for that. Because I decided I wanted to

do something with connecting computers to a large computer in Rutherford Laboratory, and do remote graphics. And that was using the fact, that from my CERN days I knew the high energy physics community well, and the high energy physics accelerator community had the largest computer in the British academia. And I could arrange to attach to it by telephone, which in 1967 was very very novel, at least the way it was being done there. They were starting to have a network of centralised pure IBM machines, but I wanted to do something with a, a different sort of machine which would do much more than one could do with the standard IBM machines at the time. So that's what I applied to do, and, eventually got a very substantial grant to do when I went, joined something called the Institute of Computer Science.

[40:02]

On the other hand, I was never replaced for the next 25 years in my GE position, so I stayed doing things with GE, by now much more in the computers area. And so I kept still travelling, in the US, in the, what by now, my computer communications specialities, and that's where I got to know much more about the whole ARPANET project. And therefore, having… 1970, '71, was a time that Britain was trying to get into the Common Market. And that meant that, Europe was good, and the US was bad. Well, Larry Roberts was involved, of course, with the ARPANET. He had just got, it had just started in '69, and, he decided he wanted to put on another part, another project which ARPA was funding, namely a large seismic array in Norway. And he wanted to connect it into the ARPANET. There were three such arrays, one in Montana, one in Alaska, and one in Norway, and if you look at your map of the Soviet Union, it's obvious why you would have seismic arrays in those places. And they already had links, telephone links, to Washington, to the Seismic Data Analysis Center. He decided that it would solve, it would be very useful for his project, if those connections came through the ARPANET, and, therefore, he would put the line to Norway into the ARPANET.

[42:03]

Since at that stage the National Physical Laboratory had a very advanced packet switched project, it was only inside the NPL for other political reasons, that the Post Office wouldn't allow them to do anything different, he proposed that Donald Davies would, they'd interrupt the line. It was going by satellite to Goonhilly, the only earth station in Europe at the time, by landline to London, and then undersea cable to Oslo. That he would interrupt it, go to the NPL, and ten bring them on that way. As I said,

at that stage, Europe was good and America was bad. He was not permitted by the Government to do it. I was known to have both good US links, I knew the people there by that time, and was also one of the few working in that sort of area in any case. So, he offered it to me. I was very happy to do it. I tried to get then support from the British Government to support that part of it, because I needed money. All he could do was to let me have one of these very important ARPANET computers, but I would have to get the communications going to Norway, and I would have to fund any manpower. I tried to get British support for it.

[43:34]
And how did it go?

Terrible. In the end I managed to find some… I… I did manage to persuade senior people in the British Post Office, who were at that stage responsible for communications, to let me have a line to Norway at 2.4 kilobits a second, for one year. Donald Davies offered me most, as much money as he could, £5,000, from his budget. However, the Research Council, who, I applied for something like a £50,000 grant, turned me down. They required support also from industry to say it was worthwhile, and I knew the people at the then British, largest British company, ICT, very well, and asked them, would they give me moral support for it? Not, not money. And, for six months, it took them while they were just thinking about it, and then they sent me a letter saying, it would be more worthwhile to have two weeks' travel in the US than to have a connection to the ARPANET. And so that was turned down. And so, managed to get something proposed between a number of different ministries, including the Department of Industry. And there was a big meeting chaired by the secretary of the Research Council, and it became clear, although I had a lot of backing for it, that it was going to be impossible to have something with four or five ministries involved. And I remember him leaning back in his chair and saying, 'Peter, this is not going to fly. But I am sure you are going to go ahead. And, in later years, you will lie back and say, and just laugh at the problems you had.' And he was right.

[45:32]
And then, you became the European father of the Internet.

Well, that was much much later. First of all, after a year, I was worried that I, that I would have to find money for the connection to Norway. I… They wanted me to do… ARPA wanted me to do things with something called the SATNET project. So, you know, I had to get serious support. And it was going to take a long time. So I wrote to the Ministry of Defence where I knew the Chief Scientist quite well, and he sent the chief of guided missiles to come and talk to me. Why guided missile, I have no idea. And in the end they gave me a contract. And it's the contract to do computer security, protocols, and, connect in the Defence Scientific Advisory Committee – to the… Sorry. The defence scientific network. And, this was fine with me. And I happened to have a squadron leader in my group at the time, so I took him up to the Royal Radar Establishment, who were going to be running the programme. First of all they were very surprised to see a real military man in a research group, and second of all, they were very embarrassed by what I was supposed to be doing. Academia should have nothing to do with computer security in those days, anything to do with security. The defence scientific network was only on paper, so nothing could ever connect in. And, so for the next few years I kept being told, what had I, why hadn't I done these things, by the headquarters people, and my project officer was saying, 'Because we asked him not to.' It took time. But any case, that then solved the problem, and we got started. After that, it took off very quickly. I had organised that I would provide services to any in the academic community who wanted to, and who were approved, and I set up a governing committee to do it. So people would apply, and that group would get, there would be, the application would go to my governing committee, would be approved, and then they would go on. Well, at that stage, there was a high energy physics network connected to the Rutherford Lab, so that people would go from the universities, come into the Rutherford and out through me, and I had connected it in so that to the US it looked like a typical, the whole of that big machine, a typical US computer on the ARPANET. On the other hand, to the British community it looked like a typical remote terminal connected to their big machine. So, that's why I called it the Janus project with two faces. And I put security in that from the beginning. So, that, that took off as a very successful project. Then we started to have the SATNET project, which involved Italy, Germany, Norway, ourselves and the US, with computers in the earth station.

[48:58]

And then, something very very important happened. When I first got the computer from ARPA, it came, and, it came just after the Value Added Tax of ten per cent had been introduced, which meant that anything being imported, you to pay ten per cent tax on it. And, the value of the machine was supposedly 50,000. So, the ten per cent was the £5,000 which I had been given by Donald Davies. I promised to pay if I had to, but I would appeal, I said. This was 1973. By '75 I now had contracts, or grants, from the British Library where I was writing MEDLINE, from the Ministry of Defence, from the Atomic Energy Authority where we were doing fusion research, from the universities, from the Research Councils et cetera. And, at this stage, I was told by, I had by that time moved from the Institute of Computer Science to University College, who didn't know me very well, that I would have to pay my £5,000. At this stage I said no. I was going to appeal again. And I appealed, and said, if they insisted, I would export my computers. And by that time there were other computers already, but, only one or two, in the Goonhilly Earth Station for instance. But then I would re-import it under the Exchange of Forces Agreement Act. The Treasury didn't want that. So they had me in for an interview, and they started asking me what I was doing with it. No interest to the Ministry of Defence? No, said I. So no interest to the Research Council? No, said I. And went through all the list of people I had contracts with, and I perjured myself and said that, none of them had any interest in the project. And I then got a letter, about three weeks later, which I still have here, and I can show it to you, which says, 'Dear Professor Kirstein. We have considered your case, and since what you are doing is of no interest to any British department, but only to the US Department of Defense, we hereby permit you to import that equipment and any future equipment under that project free of duty and VAT.' So for the next ten years I continued to run services between, firstly ARPANET and then it went to the Internet, from my research group. Every now and then people would say, 'What's a research group doing running this?' And I would say, 'Well take it over whenever you like. But you do have the following bills to pay first.' Which by that time would have amounted to quite a lot of money. And so nobody ever wanted to take it over. So that's why I told you this, it was a very important aspect of it.

[52:11]

How did your academic career develop at UCL?

Well, at the previous Institute of Computer Science, I had just started the ARPANET activity. There was a small group. It was a much smaller institute altogether with about, two, two groups of academics of something like, ten people in each group. I was really one of them. When I got to UCL, there was an existing department of statistics, which was a very renowned department, and, it was decided that this would be enlarged to become a department of statistics and computer science. And, the then statistics professor came to look at the institute, and talked about the four or five staff who were in my group, academic staff coming. And I said, 'What about my research activities?' He said, 'Research activities?' A department of statistics had no idea that that sort of thing would happen as well. And, so, we all came, and, there were at that stage something like three professors of computer science, and about half a dozen lecturers or senior lecturers in computer science who were part of this joint department. Well, after a few years the computer scientists felt that they were, with the exception of me, who didn't care, that they didn't have enough share of the management of the department, and requested that there would be a deputy head of department who was a computer scientist. Well, in the usual way, one set up a committee to look at it from the university, and, in early, in late 1979, we had a new provost, and he called me in and said that, 'The recommendation is that there be a new department of computer science separate, and that you be head, and if you agree to that, then I'll do it. Otherwise, I'll just kill the recommendation.' So, I started a new Department of Computer Science.

[54:56]

Well, for various reasons the other professors took early retirement fairly shortly, and, we were down to about five academics in this department. I stayed in the department about fifteen years, and, this was, probably too long, and it was hard to keep both the research group going and running a department, but by the end of it, we were a good department. It was probably in the first, certainly the first ten in the country. And, we had got much broader, we had probably about 25 academics by then. Somewhere around 1990 I officially took early retirement, although I stayed working there until now, mainly on research projects, but I stopped being Head of Department in 1995, end of 1994. And the department has flourished really very well, so much so that we were, it's arguable whether we were, where we were in the first two or three in the country by the latest research assessment, and it's really very gratifying to see how the

department has developed, from this very very small beginning in the beginning of 1980 to being now a, somewhere between 90 and 120 academics, depending on how you call some of the part-time academics. And, it is now a very very varied and powerful department.

[pause in recording]

[56:51]

Well, you asked about the Internet, and how that came. Well, Bob Kahn and Vint Cerf, I said, I had met earlier already. Bob was my project officer, and Vint was a, fairly junior professor at Stanford. They thought up this new Internet protocol, and one part of anything like that was, you had to have implementations. So the first of three implementations done was by this junior academic at Stanford called Vint Cerf, somebody in Bolt, Beranek & Newman, who were the people who actually provided the computers for the ARPANET, and myself, at least one of my people, or two, several of my people. And we had the first actual implementations between the three of us. So, we were doing the research on the Internet from '75 or so onwards.
[57:54]
Around about that time, or, '76, '77, there was a lot of standards work going on in Europe, and the British were part of that standardisation work. They did not approve of the ARPANET, because they regarded that as an experiment, and although the academics liked it, and they tolerated it, they certainly didn't regard it as mainstream, and, were perfectly happy to have me connecting *in* the ARPANET, but they didn't want people working on the Internet side of things. So I was actually ordered to stop working on the Internet protocols. I said I was sorry but my links to both the Ministry of Defence and the US was far too important. Whether they funded me or not, was their problem, but I was not going to stop working on it. So… I'm sure that sort of pressure went to others too. So by the time the ARPANET was moving into the Internet, I was the only person working on it, certainly in the UK, and probably in Europe. Which is presumably why I became known as the father of the Internet, because in fact, we adopted the Internet protocols in 1982, before the ARPANET did in general, not because I wanted to be a pioneer, but because my poor little PDP-9 computers were running out of power, and there was already the Internet protocols working on the PDP-11s which were their successors, and I had lots of them. So, by

going, adopting the Internet protocols for my services early, I could go on providing the service even though my computers were giving up the ghost. As a result, I found all the, experienced all these early problems, before the US people had to do it for, in earnest.

[1:00:03]

So, 43 years ago, on the 31ˢᵗ of March 1976, Queen Elizabeth II sent her first email. Would you like to tell us more about that?

Yes. In 1974, '75, I was the only international link, so I was asked to keep a very low profile, try not to get too much publicity. Well, then, the British and the US decided they wanted to collaborate on a real-time language for defence called CORAL.

Mhm. CORAL 66.

CORAL 66. And they wanted to collaborate on that. And, just about that time, I had my contracts now of course with the Ministry of Defence already, and just about that time, the Royal Radar Establishment had a new building coming up. And the Queen was going to open this new building. So they thought it would be an excellent idea if, when the Queen opened it, she actually used the ARPANET to initiate the collaboration with ARPA on this. Well, for this, one had to put in a leased line between Malvern and UCL. I talked often to the people who were putting it in, and I was told it had the second highest priority because the Queen was going to open it. And, when I asked why only the second highest priority, I was told, well the first priority was for all the telephone exchanges in Northern Ireland which were being blown up by the IRA. [laughs] So I could quite understand that this would only be second priority. And, in any case, the next question came, who was going to be sending the message, if it was a message? Would it be the Queen, or would it be Prince Philip? If it was going to be the Queen, she would do what she was told. If it was Prince Philip, he'd probably do something slightly different, and we'd have to be much more careful about what we did to avoid being able to upset it. Well, we heard it was Queen Elizabeth, so, I was reasonably happy about that.

[1:02:37]

The next problem was, that the only message systems at the time were in California, and I was running message systems, at least, they were in the US, I was running message systems under my name, my account was of course Kirstein@, something or other, OSI or whatever it was. So, I said, and I used to English for the first time correctly in my life, I asked my colleagues in Marina del Rey, would they please set up an account HME2, Her Majesty Elizabeth II, because anything else would be *lèse-majesté*. [laughs]   And it was one of the few times I've used that correctly, the only time I've used it correctly. So, we prepared the message. She sent the message. And, of course, far from keeping a low profile, everybody in ARPA and everywhere else wanted to be involved in the act. And it had wide publicity. So that was the end of the low profile I was keeping.

[1:03:53]

The next, very important, episode of that lot was a year later, when we now had the Internet protocols running experimentally as part of the research project, and the Internet protocol… It was called Internet because there were a number of other projects. We had a project called SATNET, which I was part of, using satellites in a multi-destination way. And there was one in the US called PRNET, a packet radio net, which went with, this was long before of course our current mobile telephones, but it was a mobile radio. And so, we were actually sending, in this demonstration, files from the Royal Radar Establishment in Malvern, through me, with the US protocols, then over SATNET to Boston, over the ARPANET to Stanford Research Institute, and then by packet radio to a truck going across the Bay Bridge, and when it started going to the Bay Bridge, the communication failed of course, because of the shielding from the Bay Bridge, but when it got to the other end it continued. And it sent the whole file without any errors, and restarted itself.

[1:05:27]

So this was a really momentous showing how successful the Internet protocols could be, how rugged they could be. And there are many many things I could say about the problems one had in diagnosis of those times. For instance, I was called up once, six o'clock in the morning, by the Post Office, to say, 'There's some stupid person in Boston who is calling me,' calling him, them, the British Post Office diagnostics, 'saying there's a fault between Norway and London. Tell him he's being crazy.' So I said, 'Well look, if you look in your rule book, and look under Rule 432, you will see that the people in Cambridge, Massachusetts, are allowed to report errors to you

between Oslo and London.'   And they, almost couldn't believe this, it's just not the way telephone networks work.

[1:06:36]

Anyway, we could go on, many of these sorts of things. So, we were running the Internet protocols, and we were running Internet our side. I can never decide whether I did good service or bad service as a result, because, through doing that, the British never really had to worry about the Internet until about 1987, '88, '89, because, they could go on using the Internet, but as far as they were concerned they were using the OSI protocols, and I did all the work of translating between the OSI and the Internet protocols. But of course, eventually, particularly with local area networks coming in, it became clear that the only solution was the Internet. We had, Vint and I already had a paper about that ten years earlier in 1978, where he and I had disagreed about what one does about it. I talked about adaption from one to another; he was visionary and talked about everybody *adopting* the Internet protocols. For the first fifteen years I was right, and then he completely demolished me.

[1:08:01]

What about multimedia conferencing?

Well, long before multimedia conferencing, one, throughout the Eighties… I had always had contracts with DARPA. And I always tried to do something a little bit different from the people in the US, and in fact, one of the things I'm proudest of, which I think I've got up there somewhere, is, a joke award I got from ARPA as the biggest bang for the buck. It's not that I provided big bangs in what I did, but I had very small budgets by their standards. And we did try to do something worthwhile. So, we were doing various things on networks, and, in addition of course, in 1984 the framework for programming was starting, so we're starting to do things in Europe, and one was starting to do things, and in the UK of course from 1975 onwards. So, one always had research projects which were funded by one, other, or preferably all three of these. And, this was very useful, because, one lot might fund equipment, another fund travel, another would fund best manpower. And you could play your budgets a little bit. As long as, it was slightly different, but, helped each other. And, then, in the late Eighties, in fact I remember exactly when it was, ARPA had developed something to do with… Sorry. To do with multi-destination, multicast.

And this was particularly good for discussing decision, situations jointly between numbers of different parties. It included some conferencing with it. You had pictures, you could get sensors coming in with information. And the very first of these was going to be shown as a very major international demonstration from my basement in late nineteen, I think it was '89 or '90. I'll have to look it up, which it was. And, although they had put a lot of effort into it, only three medium-level MoD people turned up of his demonstration, which was going to be, really like just a two-minute war gaming. Everybody was disappointed, until the next morning. They suddenly realised one had chosen, ARPA had chosen, the evening of Desert Storm [laughs] to try to do this demonstration. And of course, in the US, there's such a separation between operational and research, that they didn't even know about it. In the UK, anybody who was concerned with defence research policy was of course busy with Desert Storm. But, this was one of the first examples of these Internet type of things going over for conferencing.

[1:11:42]

Well I became very interested in that, and had a whole series of projects, partly funded by the British, partly funded by the Europeans, because I was doing multimedia conferencing over the European networks, which were developed, and partly on the US side, where I was doing it with the US, and where I started doing things like demonstrations, I had one big, major one between three hospitals doing prostate surgery, where, as you know, prostate surgery is rather delicate parts of the body. And there I was so appalled with how careless the doctors were of showing both the parts of the body and people's faces, that I decided you couldn't possibly do this sort of thing without security. So I then became interested in secure conferencing. And again, all these things are well-known now, but in the early Nineties they were not. And so, there was a whole stream of activities I was doing around that time. You also remember that the bandwidths were much lower, so we had to do some work with redundancy in the speech, so that, if you missed packets, because of course, IP is not reliable communication, at least, it's best not to make it reliable for real time, then you at least can partially reconstruct the bits you've lost, because you had low bandwidth redundancy in previous packets. So we had lots of this sort of thing, for, about ten years or so, until the commercial versions of codecs and things made it impractical to continue them in a university setting.

[1:13:56]

But, again, one had a lot of problems in introducing Internet technology to any of the projects of the Europeans. And I remember being very very amused that Cadu was in charge at one time of the ESPRIT project, which was one of the major European projects, and at that stage he was terribly against anything to do with Internet technology. But then, he left the ESPRIT project and joined NATO, and became the director of the Science Programme. And, miraculously, suddenly, the Internet became the best thing since sliced bread, [laughs] and all his previous objections vanished. When you remember how much funding the US provides to NATO, and how he could change so suddenly, I found very interesting. [pause] So I think that's basically the story of the multimedia con-

[1:15:05]

Oh yes, one more thing about the multimedia conferencing, also a political side. When I first started it, I thought it would be very important, again from my old community, for CERN to want to collaborate with the US laboratories, using multi-, using the conferencing. So I proposed that to my colleagues. This must have been about 1991, 1990, 1991, in CERN, where I still had good contacts. They said, 'Peter, you are wasting your time. At the moment the Americans are trying to persuade Bush Senior to fund the superconducting supercollider accelerator. The last thing they want is to show you can collaborate well with CERN. They want to get their funding first.' So, I didn't even try that, it would have, it was hopeless. However, once the SSC was killed, and the LHC, the Large Hadron Collider was going ahead, and it was agreed that the US would also join in the funding for it, suddenly, multimedia conferencing again came a marvellous thing, and CERN developed, together with the US, people in Oregon, a good system which we collaborated with as well. [pause] Technology does not exist by itself. It only exists in a political framework.

[1:16:45]
So, what can you tell us about the SILK project?

As… As I know you know, in 1989 the Berlin Wall came down. Somewhere around 1990 the Soviet Union collapsed as the Soviet Union. And, as a result there were a lot of parts which had been on the edges of the Soviet Union, which became independent. And in fact the collapse of the Soviet Union started when there were riots in Baku in Azerbaijan, and that was almost one of the first sets of real riots which led to the

collapse of the Soviet Union. And so, there were at least eight or nine of previous Soviet thing, parts. And in addition to that, there were all the satellite countries, which suddenly had a lot of scientists running around with a lot of knowledge which one didn't really want to see going to rogue states. And so, NATO decided to have a science, part of their science programme, to fund programmes in all these countries, small ones, but in several areas, life sciences, physics, because of the nuclear of course, environmental because those were needed. I've forgotten what others. Materials I believe. But then, that had to be supported by computer networks. And so there was a, they started a computer networks panel. The chairman initially was by that time well-known, called Vint Cerf, and, I was there from the UK, and I've forgotten who the others all were, but, I do know who they were but… And, we were really, we were just a funding body, just to approve proposals. Met three times a year. And, then, originally were funding computer network projects in, initially mainly Eastern Europe, a little outside. But by about 1988, '89, the Eastern Europe ones didn't need us any more. They were, many of them were starting to be even part of, of the European Community, and, the effort went mainly towards the Caucasus and Central Asia.

[1:19:55]

Well I had been on the committee from its beginning, and, I had suggested already in the middle Eighties – middle Nineties, from my experience of international projects as part of my framework activity, that we should always have all our grantees coming to at least one of our meetings once a year. And they did. And, also, that we wouldn't continue to support… We earlier had to advise on any computer purchase for any of the other panels. I said this was stupid. And so, we started supporting, mainly network programmes in which there were national network programmes, in Armenia, Azerbaijan, Georgia, Kazakhstan, Uzbekistan. Kyrgyzstan I think at that stage already. It doesn't matter exactly which ones. But there were quite a few of them. And, each time we were supporting a network inside the country, we were also approving something like 64 kilobits a second, or sometimes even as much as 128 kilobits a second, for Internet connectivity. Well, three of us, of which I was the leader, I was at that time the only one on the panel, said this was silly. We shouldn't just be approving small amounts of bandwidth; we should actually run, propose a network. So we proposed a network, round about 2000, which would be a network which would connect in to each other all the national networks in these countries,

which had been funded either by non-government organisations and charities, or by NATO, or others. And, we would put them all into GÉANT, which was now the European academic network. One of my colleagues there was Hans Frese, who was from the Hamburg DESY, Deutsches Elektronen-Synchrotron institute, and he together with the leader of the German academic network had agreed that they would act to put in their networks. They already were doing something earlier as part of their physics activity, and they would agree to allow the whole network to go into DESY, and from DESY to go into GÉANT. And so we proposed this as a project.

[1:23:05]

Now, the first problem was, this panel had been just a, a funding agency, and suddenly this was a real project. And there was no mechanism inside NATO to fund projects, and certainly not to fund manpower to manage them. So, I persuaded some of my contacts in the European Union – European Commission, to do something which as far as I know is the only time it's ever happened, to fund the management of a NATO project from the framework programme. And also persuaded Cisco to donate equipment, like a router and a web cache to each of the republics of the Caucasus and Central Asia, and of course NATO to fund this as a project.

[1:24:11]

So, in early 1991, when I was now chairman of the panel, that project was funded and started. And the first proper meeting was supposed to happen on September the 20th 2001. And you may remember that something rather nasty happened on September the 11th 2001. And of course, NATO immediately grounded all its staff, no one was allowed to travel. The first meeting, well the kick-off meeting was supposed to be in Lake Issyk-Kul in Kyrgyzstan, and, I said that it was extremely important that we still hold that meeting, and that we attend. And if there was any time that it was important to show that we were serious in Central Asia and the Caucasus, that was the time. So, much to the concern of my family, I said I would go, if I could persuade the NATO programme officer to come, and, he had to appeal right to the Secretary-General to get permission to come. But we had the meeting. And at this critical time, there were all these republics, which, themselves often on bad relations with each other, were going around in a circle, at Lake Issyk-Kul, talking about the Central Asia and Caucasus research network together, and it was a very very moving kick-off ceremony.

[1:26:06]

Well, it was only a three-year project, and, by the time it got to 2004 or 5 we needed to renew it. Normally it's very difficult to renew projects like that. I, by the way, had stopped being chairman, it was only one year at a time by then, and had become the director of the project, funded, as far as that part of it was concerned, by the EC.

[1:26:37]
Did you travel there often?

Yes. Because, again, because of what I was used to from international projects in Europe, I wanted to have meetings every three or four months. This was not easy, because, for the first project nobody would fund travel, at all. We managed to arrange it around, around various meetings going on. There was a, there was NATO workshops, and we always held them around that. In the contract, which in those days, I was part of the negotiating, we did some questionable things about, as part of the contract of providing the communications satellite capacity, because of course, in those days the only thing you could do was satellite. Fibre was, it was too early for fibre in those parts of the world. They included one meeting a year funded by the company. So, yes, we, we had meetings every four months or so initially. And one of those would be in Europe, and the other two would be in the countries. And it was absolutely essential. But a little bit later, by, when we had the next set of these meetings of the project, when we tried to first of all, one found that this was the only project which NATO was supporting which was a regional project. They had lots of national projects, but none which covered all the countries of the Caucasus and Central Asia. And this network had earth stations in Azerbaijan, Armenia, Georgia, Turkmenistan, Uzbekistan, Kyrgyzstan, Kazakhstan… [pause] Oh, there's a fifth one. I don't… Oh, of course, Tajikistan. And then, in 2006 Kabul came on too.
[1:29:10]
 So, this was something which everybody was very happy to see funded. We also had, usually, started having workshops which went with them in various things. And I remember one which I held in Turkmenistan in about 2008 or 9, actually had two women from Afghanistan in as well, and that was remarkably rare. In fact we normally funded only two, but in this case there was one man and, we wanted to fund one other, but the women said, either two women or no women. So of course, NATO was only too happy to fund two women from Afghanistan at that stage.

[1:29:57]

So yes, we met every three or four months, four months usually. And in fact towards the end it was twice a year, just, so six months. And, then, there was great difficulty, one was trying to get partial funding from the countries; that was very difficult to arrange. And, round about 2009, 8, 9, the EC took over the running of the Caucasus portion of it, and about, a year and a half later, they took over the running of the Central Asian part of it. And at that stage NATO was only running the Afghan part. And that was different. First of all, I couldn't really run the Afghan part in quite the same way. Afghanistan is not the sort of thing an academic can run inside the country. So, the contracts by that time were being organised by NATO completely, and, it wasn't quite, it wasn't as satisfactory. But the other very important thing which happened, because you asked about this, was that, Cisco had, I had said, earlier donated equipment; well they donated, donated some telephone switches. And, while originally we ran these things from DESY, I started running them from UCL, a telephone system inside all these countries, for SILK purposes. And we would have very regular audio conferences, and once a month video conferences, using the sort of technology which I had been doing research with earlier in multimedia conferencing, at one stage, later different technologies, but in any case, we were running multimedia conferencing to all these countries, once a month. And, again, you run into experiences like, apologies from the man from, particularly later when I was running the Afghan part, from the man from Kandahar saying he was very sorry but there would be a lockdown. He was late for his meeting, because there had been a lockdown where there had been a missile attack. [laughs] So, there, I once went to Kabul, but, that, what happened there was more, again, there was no provision for meetings once we took over just the Afghan part of it.

[1:32:50]
So what's your memory of Kabul?

Well, first of all, most of the meetings were in Dubai.

Ah. OK.

I managed to persuade Google to fund… A man from Google came to UCL, and started saying, well, their programme with universities was very small research projects, and workshops. And, so I had lunch with him and said, well, I have this workshop I'd like to run. It's going to have, would have, four ministers, five presidents of universities, and, something like six academics who are running the networks in their universities. 'Is that the sort of thing they meant in the workshops they were going to fund?' He swallowed hard, and said, 'Well not really. [laughs] But, I can, I might be able to fund it. Send me an application. But I can't do more than $10,000.' So I sent him the application. And he responded immediately, saying, 'Well, we decided, instead of 10,000 we'll give you 12,000, and we can't fund government ministers. That's against what we in Google are allowed to do.' So, I found other funding for the ministers. And then had a whole… But, once the one had been funded that way, NATO was rather shamed, and they started funding a series of seven of these things. Well one of them, in 2012, 11 I think, anyway, it doesn't matter, was in Istanbul. And that was just when there were problems in Istanbul, and the Afghans wrote, 'Is it safe to go to Istanbul?' [both laugh] [pause] Well, we were having problems with continued funding, because NATO became less and less interested in Afghanistan. And they were going to stop it. And so, they had given plenty of warning, but of course, their official contacts was mainly with people in Kabul. And I had my doubts whether the messages were going properly to some of the outlying universities. So, one time I went to Kabul too, and found, to my horror, that the universities themselves, in the remoter parts, knew absolutely nothing about what was happening. I had sort of told them on the video conferencing, but they didn't really fully understand what was happening, certainly not at the senior level, because it was more the junior level of people who took part in these conferences. [1:35:47]

Kabul, you asked what was it like. Unpleasant. Wherever you went, you went in two cars, and, for our hotel, you would have the cars going in a V shape. You got out in the middle of the V. They drew their guns. They… You knocked on a door, and an armed guard opened it. Quickly closed it. Knocked on another door, and an armed guard in the courtyard opened. And then you went into your hotel. Well, it was my fault. My family was not very happy. I was the only one of, of us who actually went to Kabul, that and the NATO programme director. I'm afraid the others did not wish to go to Kabul. And, I could have gone to stay in the rest house run by the Ministry of

Education. I think that would have been very much safer, because, they had big grounds, and they would have had plenty of warning if terrorists had come in. I was in what was supposedly a safe house of, a safe hotel, but whether those were really safe… About quarter of a mile away was the NATO headquarters in Kabul, with a balloon, a barrage-balloon, a balloon above it, with surveillance equipment to see if there was going to be any attacks. And, it was just not a very pleasant atmosphere. We were invited by some ministers to, to a dinner in a… and, our NATO cars refused to take us there. So the next night, rather than that, we went to a dinner hosted by some other of the ministers. We, was the NATO programme director, and somebody from Cisco who came too, and myself. And then the NATO cars fetched us from there. However, that was the hotel which had a very nasty incident only two or three months later. So… And I think it's got worse since then.

[1:38:31]
OK. [pause] What about Internet of Things?

The Internet… Well, I became interested in applications. The whole of the Internet itself has become a very commercial and a, a very professional activity. And, I haven't been very interested in going, in staying with any of the standards activity, or any of the really important, very worthwhile, research activities to do with the Internet or even the next generation Internet technology. On the other hand, I have been interested in applications. And I also became very interested in IPv6. So, another phase of my activities in 2000 was first of all in promoting IPv6, both in European projects and including some with Africa as well. And, then became interested at the same time in emergency communications. And emergency communications is a place where the technology itself being used is often rather dated technology, but it would be particularly good if one could use some of the more modern. And in fact, there are significant advantages in using IPv6 for it as well. And so, this was how, my first introduction in a couple of projects which we had between 2006 or 7 and about 2012, which were in emergency communications but involved also a whole variety of things like ambulances and, video cameras, and IPv6, and, the sort of things which we now regard as being part of the Internet of Things. And the latest of those which I was involved with was one to do with buildings, and architecture, and there was something called IoT6. And I enjoyed doing that.

[1:41:20]

But then, renewed some of my interests in what my old friends had been doing, Bob Kahn in particular, where he had been doing something to do with very large-scale databases built on the same lines as the DNS, which he had been using for things like, media. If you, if you're looking at things like films, there are probably, 50 versions of this film. There is the film itself, the first film; there's the film in different languages; there's the trailers of the film; there's the version of the film for television in this one; there's the high definition version. So all of these things need names, and security becomes very important. So, he developed a very good system for keeping track of these things. I thought that this would work extremely well for buildings automation. So we started having a project, first of all in the IoT6 project, I started doing a little bit of it in there; then I did some more work on it afterwards. I think it would have been very, would have worked. But… And I had a small project with it, but I didn't… It didn't work very well here, because in fact it ran into some objections from our own funding agencies, who, it didn't quite fit in with the sort of way they were doing things to use a US-based system for it. But I still think that things based on that sort of technology is one good basis for the Internet of Things.

[1:43:32]

There are now a whole set of projects under the framework programme. But these are all difficult. I mean if we're taking now about the project area, it's not clear how the research parts of the things are or should be funded. I have been part of the PETRAS project, which looks at security in the Internet of Things as a separate entity. I believe they have dealt with it, it's now just moved into having a proper centre of it. But the problem comes that, you, it's very hard to say whether you should do these things on a long-term basis, on a short-term basis; whether you should be concentrating on the technical, or on the commercial; how close it should be to the, transforming the industry in the short term; how much it's related to 5G; how much it's related to the low power networks. All of these come into it. And it is a very very complicated area, but a very important one. If I was 20 or 30 years younger, I would be doing it, working on it very enthusiastically. As it is, it's easy to work at small bits of it, but to actually work in large parts of it, important parts of it, takes an awful lot of energy of a political as well as technical nature. That, for lots of reasons, I think it's too late for people like me.

[1:45:34]

So, what are the proudest achievements of your career?

I think it is the general international activity that, I have been able to bring together communities, on quite a large scale. I was one of them, Vint was another, on the beginning of the committee looking at ERNET, the Indian research network. That led to some very very important later network activities in India, of a major sort. SILK, it's too early to tell I'm afraid whether that's going to be really successful or not. Those are countries where the politics are very difficult, politics and economics. But the fact that so many of the things were able to be international, collaborative, and that they could combine many different types of things and people together, I think that's what I have enjoyed most of it.

[1:46:58]

Is there anything you would do differently if you had the chance?

[pause] Well… It's difficult to know whether one should take on the political authorities quite as much as I have done. It might be easier if one lived with what they were doing, but you probably wouldn't have quite as much impact if you had. So it's very hard to say. What I particularly don't regret is the decision to stay in Europe, rather than go to California. Because, I think it's much more difficult to have that sort of, to have a serious impact in such a large and diverse country with so many very complex counter-currents as the US. And that's something you particularly notice with things like SILK, where, I remember opening a lab on behalf of Cisco with, opening jointly with the then acting president of Kyrgyzstan. Now, it was only because the president of Kyrgyzstan happened to out of the country, and the vice-president had just lost his job, and the minister who I was working with was therefore the acting, deputy minister and then acting prime minister, but still, to get close to that level of people you will get to there, because, you are making a difference.

[1:48:55]

How do you think IT will impact society in the next ten years?

Well, I think from some points of view, it will look much more negative. From the point of view that it is clear that the purely technological and business ways in which the Internet has been, and applications have been running, will not continue. You just look and see some of the strong concerns at what's happening in the social media and its relation to terrorist, to self-harm, to pornography, that, it won't be allowed to continue this way. And that means also that the climate will become much, much more difficult. It won't be as interesting from a technical point of view to work, because you are going to have to worry very much about the political sides. On the other hand, that does mean there will be huge scope for a, much more rounded sort of researchers and research groups. And PETRAS is a good sign of this, where it's the, social sciences, psychology and others, who come in at the same time, those concerned with governance, the same time as those with technical. And you will, you need to reach across boundaries in a way which one didn't need to in the previous set of activities. And, you ask what's going to happen. I think, it's the growth of that, that together with the important aspects of large data, and of security, and in both cases it's not just the technical. As we know, in the security case, an awful lot of it is from people who themselves jeopardise the security of their organisations because of the phishing attacks and others which are looking at the, the weaknesses due to the people side, as well as the technical side. It's going to be very difficult to deal with that. And again, not necessarily a pleasant way of dealing with things. The large data side, again, huge capabilities, both for good and for bad. And, we aren't used to having to worry about the ethical sides. One did worry about that to a limited extent with the A-bomb and the H-bomb. One worried much less about it in things like the Internet, and suddenly one is now having to.

[1:52:12]

Mhm. What advice would you give to someone entering the information technology sector today?

[pause] Keep as open a mind as possible, not only on what sort of areas you work in, but of, other areas which will influence your work. Try not to, try not to be narrow, and yet that's very time-consuming. Learn from the beginning to read widely. The capabilities we have now with the, with others, finding out what's going, and for staying in contact, is so incredible. But, you've got to be used to wanting to do it.

And, too often people don't even try very hard to do it. That, if you want to be successful, I think that's how… If you want to have impact, that's something you must make sure of.

Thank you Peter. It's been a real pleasure talking to you.

Thank you. I have enjoyed talking to you. If I have done most of the talking, I apologise.

That was the goal of the interview.

[End of Interview]