Interviewee: Shigeki Goto

Interviewer: Fan Yuanyuan

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Transcriber: Hong Wei

1:34

FYY: Ok, so let's begin. But today is thirteenth of April, 2018.We're in office of cyber labs in Beijing and we feel so honored to be able to interview doctor Shigeki Goto here? Am pronouncing it right? (Yes). I'll briefly introduce the history of Internet project to you. The project is launched in ……

It's launched in 2007 to celebrate the first fifty years of the Internet by recording and preserving the personal narratives of global Internet pioneers, uh, their extraordinary contributions to the Internet development. And by 2018, we should have interviewed 500 Internet pioneers, as we planned, and by now is interviewed more than 170 pioneers around the world and about 80 are from overseas of China, and let's start from the very beginning of you like, uh, your name, where and when were you born and what did your parents do, when you were young?

SG: I was born in Utsunomiya city that is near Nikko, Tochigi Prefecture

in Japan. Both of my parents basically were school teachers and my father spent most of his life at the unified school district. He was a school teacher. He worked for the administrative structure of the school system. It covers from elementary school, middle school, and high school if they are public.

FYY: So that's a big school covered all three…

SG: Yes. All the regional public schools are under control of the unified school district. It's a part of local government.

FYY: And when were you born?

SG: I was born in 1948. It belongs to the first half of the 20th century. So I'm old and about to retire from my university.

FYY: Looks much younger than your age

SG：I just compete with my students.

FYY：Yeah, okay. And your mother？

SG：My mother is a very local person in Utsunomiya city. Her family runs

a liquor shop originally. It deals with other goods, like soy sauce. It's a grocery store. Now, her brother turned their shop into a convenience store.

FYY: Great. And who's… Because your father is a teacher. So do you think he influence you a lot? (uh) Do you think your father influenced you a lot?

SG：Not so much. My father was a teacher in arithmetic or mathematics. But he likes to make something by himself, like the wooden chair or table. He was trying to develop camera films or pictures by himself. Those activities might influence me because my hobby, when I was a school boy, is amateur radio. I built my own receiver and transmitter equipment by myself.

FYY: When you're a little boy.

SG: Yes. When I was an elementary school boy, or a middle school boy, we need a license for a radio station. It's a national license. It's not so simple to transmit a radio signal. Only receiving a shortwave communication is much easier. Transmitting some power of radio signal, we are requested to have an official license. We should study some basic electrics and also some law or a legitimate system for wireless communication to pass the examination to get a license.

FYY: Uh, that's when you were in middle school,

SG: Yes, I was a middle school boy. Then my friends and I individually have our own radio station and collectively set up a club station hold by our middle school. We built an antenna on top of the school building and operated a radio station as a club.

6:50

FYY: So anything interesting happen over there.

SG: My experience in running a radio station gave us some sense or a feeling of communications in amateur radio. It connects us with a variety of counterparts who are randomly selected. We just start the call with an initial message and someone responds to us at this moment. In some sense, such kind of feeling is still kept in the Internet. If you put something on the web, you don't know who will browse it.

FYY: So how about your childhood.

SG: Childhood? In my childhood, I mostly spent my time in making something, making handicrafts. They were electrical equipment and some

mechanical unit. When I was a schoolboy, I made a telescope to observe the surface of the moon. It had a big objective lens and an eyepiece. However, the performance is not so good at the time, and not comparable to a professional quality, great telescope. Still, it's fun to make my own telescope.

FYY: So you made a lot of things by yourself?

SG: Yes. I followed my senior friends. I learned many things from them. At that time, Japan is recovering from the big damage during the world war two.
Everything was growing up, including electronics tools and equipment. People were changing their lifestyle and everything.

FYY: So, your father is a math teacher?

8:37
SG: Yes. However, he spent so many years in the administering office for schools.

FYY: Yeah, so uh, you chose math as your major in university. Uh, so that's, uh, because of your father make you take interest in math.

SG: The reason why I took math as my primary subject at the university was not affected by my father. Since my interest was stimulated by amateur radio, I wanted to understand a theory beyond simply transmitting signal in daily operation. There is a theory, like Fourier analysis or Laplace transform. They are all mathematics. I believed that mathematics is the real foundation of science or even engineering. That's fine. I took mathematics as my primary subject at my university.

FYY: So, is it easy for you to in the math?

SG: No. I had my own motivation for studying math. However, most of my friends at the department of mathematics at the University of Tokyo are very good at mathematics. Some of them are above my level. I investigated several possible research themes. Then I was interested in a computer at the department. At that time, the number of computers is small at Japanese universities. There were very big computers on campus which are called main-frame. Each university had only one or two big computers which cover all users in a university. There was no personal computers at that time. To use a computer, we should write a program and manually check or debug it by ourselves. And wait for the real use of the computer. It took much time for waiting, but it's quite interesting to watch my program

running.

My department of mathematics had a small size computer which is called mini-computer. Also the next door department of physics had a much larger computer. We asked professors at both departments to use it. Fortunately, they allowed us to use a larger computer. We could do many things on small computers. For example, one of my friends, who is now a professor emeritus at Kyoto university, was trying to solve a puzzle on a computer, even though the memory size or processing speed was not comparable to today's PC. Still it gives some nice feeling in programing, If we have a good algorithm, then it works. That offered a very enjoyable experience for me.

FYY: And so when was that?

SG: In 1971, I graduated from the department of mathematics. At the time, my primary work is not pure mathematics. I worked on numerical analysis, which aimed to solve differential equations by computers.

If an equation is not solved by analysis, we try to solve it numerically, that means using computer. As a research theme, one should solve a very difficult equation by using computers. We call this method numerical analysis. According to my professor’s advice, I tried to solve a very, very difficult equation.

That is Navier-Stokes equation. It has not been solved yet because it's very difficult. It's a nonlinear equation. If we could solve it completely, it helps designing an airplane much easier, because Navier-Stokes describes fluid dynamics. It is applied to our daily life as well. If you move your fingers in hot water in a bath tub, it shows an example in fluid mathematics. Such kind of calculation is very, very difficult and complex. If you move your fingers slowly or very fast, the results are totally different.

FYY: Ah, so it's all basic math

SG: Yes. It is really sitting on the mathematical theory. In the area, Russia at that time Soviet Union and Japan are forerunners. I had to read a paper in Russian language. It took me three days just for reading three pages paper. But it's worthwhile because the first step should be trying to solve the equation up to the approximate theory described in the Russian paper. After the reading the paper, I wrote a computer program, it calculates the approximation. It is not hundred percent accurate, but trying to solve the equation using existing approximation method and then call for help from computers.

FYY: So that that's when you first touched the Internet?

SG: No. Numerical analysis did not require the Internet. I started my activities in the Internet after I joined NTT Laboratories, Japan. Through my experience in numerical analysis, I became quite interested in computers. Then I joined NTT Laboratories after I finish my master course in mathematics. NTT is a Japanese telephone company. It was also doing data processing business. Later, the business was taken over by a new company named NTT Data Corporation. It is a split off from NTT Headquarters. When I joined NTT Laboratories, NTT was a single big company who covers many business areas. I started working in a research project on computer architecture. They try to design or build a new computer which is different from main-frame structure. I found it was not an easy project because the new computer needs many researchers and engineers. I was just one of members of a big team. Then, I left the team and I switched my research subject to a kind of artificial intelligence. Artificial intelligence right now is typically based on machine learning, like deep learning, which is sitting on statistics. It's a kind of mathematics. At the time when I started my new project in artificial intelligence, it is based on mathematical logic. In the area of artificial intelligence, we have three boom periods. The current period is called the third boom.

I joined the second boom of artificial intelligence. I had a dream to write a computer programming automatically. It's called the synthesis of computer programs. This method is sitting on mathematical logic. Since I graduated

from the department of mathematics, I know some knowledge of the fundamental theory. And I was a computer scientist at NTT Lab, then I know how to write a computer program. My plan was to combine my knowledge to have a solid basis for my dream to automatically synthesize computer programs. That was my plan.

We were in the second boom of artificial intelligence. In Japan, there was a huge national project of Japanese government, it's called the fifth generation computer systems, FGCS. Nowadays, the term of fifth generation usually means 5G wireless in cellular phones. However, the fifth generation at the time was trying to build a new computer which is suitable for applications in artificial intelligence.

I helped Japanese national project FGCS. It started in 1980, and it covered ten years. Then at the middle of that project, I stayed at Stanford University in US as a visiting scholar under the leadership of Professor John McCarthy. He is a real father of artificial intelligence because the name of Artificial Intelligence (AI) was coined by him. He is one of the fathers of AI. The other father is Professor Marvin Minsky at MIT. So artificial intelligence has two fathers and No mother. I did some work at Stanford University. For example, I wrote a research paper on my synthesis method for computer programs. It was presented at the international conference IJCAI (International Joint Conference for Artificial Intelligence) held at UCLA in August, 1985. After the conference I returned to Japan.

Unfortunately, I found that my dream is infeasible. (Why) I could not carry my plan. There was a theoretical barrier which could not be overcome. I proved the negative result by myself. Then, I wrapped up all my achievements and prepared for my dissertation. There is a good Japanese system. One can get a PhD degree from outside of university if you have enough number of journal papers. I enjoyed the PhD system in Japan, and I earned a PhD degree from the University of Tokyo. When I was at Stanford University, my position was a kind of Post Doc. Post Doc is a young researcher who just got the doctoral degree. Actually, I did not have a doctorate degree when I was at Stanford. After I returned from Stanford and then got a PhD degree from the University of Tokyo. Anyway, my dream in artificial intelligence had simply failed.

So, I gave up my dream. However, one thing was left over. After returning from Stanford University, I need a communication link to continue the joint research between Japan and US. There was another need from my colleague at NTT Lab. His primary work is semiconductor research. He came back from MIT and asked me to have a good link to US. Without good communication media, we could not conduct joint research projects with US universities. Well, there are more people in NTT Lab. They all needed smooth international communications. In japan at the time, JUNET which is Japanese University Network or Japan UNIX Network was started during my stay at Stanford. I stayed at Stanford University just one year

from 1984 to 1985. In 1984, Japanese network started based on not TCP/IP but based on UUCP, which is a build-in protocol in UNIX. At that time in US, the most popular protocol was TCP/IP. Many people say that the real origin of the Internet is ARPANET. It started in 1969. However, the protocol is not TCP/IP in 1969. They changed the old NCP protocol to TCP/IP in 1983. When I visited Stanford University, it was 1984. I have experienced the very beginning stage of the Internet which is used today. I met with Leonard Bosack who is the founder of CISCO which dominates the major market of routers and switches today. Len Bosack was a research associate at Stanford University. Now, Huawei is competing with Cisco or Juniper or other Silicon Valley companies related to CISCO. Some of former workers at CISCO set up new companies. Anyway, I know Leonard Bosack, then I purchased one single box from Leonard Bosack in 1985. CISCO was running by three people, which was a very small company in Menlo Park just next door to Stanford University. They made a router which is sometimes called a gateway. At NTT Lab, there was a high demand for communication with US. Then, one of my friends, Dr. Kenichiro Murakami, who is now a professor at Hosei University, successfully modified CISCO software, IOS, to realize a TCP/IP connection between Japan and US. At that time, Cisco was a very small company running by three people. They were quite helpful to realize the international link. We use the packet switching network X.25 and TCP/IP.

We needed some modification of CISCO standard software. Kenichiro Murakami realized the first IP packet between US and japan. It's 1988. (1988)

That was one of the real origins of Japanese Internet. We also helped Japanese universities connecting to JUNET. The university of Tokyo helped other universities as well. We collaborated nicely to encourage people nationwide. Even though Japan is a small country geographically, however the cost of long distance call is not so cheap. Many people realized that using the Internet is quite meaningful for communicating with their friends. Then, we picked up regional universities like Hokkaido University, Tohoku University, Tsukuba, Tokyo, and not Nagoya University but Toyohashi, and then Kyoto, Osaka. Kyoto and Osaka are located closely. However, they both are very strong universities. And we connected Kyushu University. These universities formed the backbone of JUNET.

That was a very first part of the Japanese Internet history and realization of an international link. That's the reason why I’m currently doing some work in the Internet. For example, our friends in China knows CNNIC who allocates IP addresses and domain names under .CN. The organization is called CNNIC. We set our JPNIC in Japan similarly. Initially, it's based on the UUCP connection. We call the volunteers in JUNET as junet-admin. The initial stage, the volunteers worked well. After expanding the coverage of the Internet, we needed some money to maintain the database for IP

addresses and domain names. It's getting larger and larger. We definitely needed some handling fee under an official legal organization. Now, we have a non-profit organization JPNIC. Currently I’m the president of JPNIC. The reason why I’m working for JPNIC is simple. I was one of the initial members who started the volunteer work to allocate IP addresses and domain names in Japan.

23:55

FYY: So that's how you uh get involved in the Internet business.

SG: Yes, that's right. And I worked also for Asia. For the initial period of the Internet, all the IP addresses are allocated by an organization in the US. It is called SRI-NIC because it is located in SRI (Stanford Research Institute) and NIC stands for Network Information Center. Then, the Internet became a global activity especially after 1991. Many people know from history or time-line that ARPAnet stopped its operation in 1990 and commercial operation of CIX, Commercial Internet eXchange, started in January 1991. We certainly had IP connections between Japan and US before 1990. Still, it was an epoch to open the door to the global Internet for many countries, and the commercial use was allowed in 1991. Our connection from NTT to US was an IP connection which was established in 1988. It was necessary to get an approval from US government. We

negotiated with NSF, National Science Foundation, who was running NSFnet and also DoD, Department of Defense who is responsible for ARPAnet. In fact, it took half a year to settle it down, because none of US government agencies are willing to accept an IP connection from outside of US. UK was the only exception for ARPAnet. If you take a look at an old map of ARPAnet, you may find UK is connected through a satellite link. That was the only one exception. Finally, we successfully got an approval to have an official IP connection from Japan to US. It took a long time. We had a very good English speaker, Dr. Yasuki Saito, who is now a professor at Kyoto University. He negotiated with US government agencies, and finally he was successful. Recently, I recall our successful negotiation and I said to him that we got it. Dr. Saito replied to me, saying “Dr. Goto, you forgot all the troubles, difficult negotiations and a long process we should follow. You just summarize the very last part. I always sent copies of all the message to you for half a year.” That`s human life. We forgot troubles and negative things, we keep positive good things in our memory. Anyway, our experience may be helpful to other institutes. After ARPAnet stopped, NSF ran their NSFnet. We had observed US networks from an earlier stage, and we officially connected to CSNET. CSNET was basically the successor of ARPAnet together with NSFnet. We became an official member of US activities at the very early stage. That sounds very good.

I should describe Asian history. As I mentioned earlier, US allocated IP

addresses and domain names at the beginning. Someone may ask the reason why only US universities can apply for .EDU domain names. (Yeah) The reason comes from the history of domain names. It's originally a US scheme to use .EDU and .GOV for domain names. They're all US domain names. So Asian universities cannot use .EDU. We have discussed how global domain names should be formalized. It is essential to keep the uniqueness of domain names. It means there should be no duplicated domain names in the world. It was time to divide the domain name space to cover other regions than US. Then APNIC started in 1994 as a pilot project. US NIC gave us the database, which includes Japan, Australia, and New Zealand. It had many entities and we called help from our friend in Korea and also Taiwan. They were quite well connected to the Internet at that time. If you cannot call it Taiwan, it's Chinese Taipei. (Taiwan is OK) The very beginning of APNIC operation is formally setting up in January 1995. The first APNIC meeting was held at Chulalongkorn University Bangkok, Thailand. From China, Professor Xing Li from Tsinghua University participated in the very initial activity of APNIC. We asked our friends in Thailand to host our very first meeting. Mr. David Conrad, we call him Randy, was the general manager to run APNIC in Tokyo. We maintained a database and it is basically a part of JPNIC operation at that time. The size of IP address space was smaller when we started APNIC. Now the size of IP address block is huge. And the domain name structure

follows a different hierarchy from IP address space. Later, we formed ICANN. And APNIC now have their office in Australia. It has much bigger operation compared to the beginning stage. It is very natural to utilize IPv6 addresses because China is a very big country and the demand for IP address blocks is very large. The original IPv4 is not enough for China. IPv6 deployment in China is already the top level over the global Internet because you have many users of the Internet. And you have good big data. To design a good configuration of the Internet, we really need a measurement, statistics or data. Even if you design a quite fancy network, the issue is a good use of it. If you are putting a high speed fiber and install a supercomputer, your user is not comfortable if it's not connected to a good network. When you utilize a network, one cannot realize both of infinitely large capacity of communication and infinitely high speed of computer. We need good balance or trade-off in allocating resources. Then we enjoy the best use of the network.

In China, you have many, many users. If we count the number of universities or count the number of research institutes, we understand why both of CERNET and CSTNET are very large. Also Chinese citizens use and rely on the Internet. So, you have good data, real data. You may have an excellent idea to improve the current Internet, because you can analyze your big data. It is essential to have good data.

31:41

FYY: So since you mentioned the beginning of the Internet in Japan, oh, I heard that the… Do you know the father of the Japanese internet? It's Jun

SG: Jun Murai,

FYY: So he he's also involved in the JUNET.

SG: Yes, exactly. JUNET is sometimes called Jun's network. Professor Jun Murai is a very good friend of mine. You will surely make the interview to him. He is younger to me. He was a PhD candidate at Keio university. And he became a research associate at Tokyo Institute of Technology when JUNET started in 1984. After JUNET started, he was invited to the University of Tokyo and became a research associate at the computer center. Jun Murai together with Dr. Jun Matsukata managed JUNET at the University of Tokyo. They are good friends, and they happened to have the same first name Jun and JUN.

FYY: So it's JUN net.

SG：Sometimes we happen to make a lucky combination. The University of Tokyo is a center of Japanese university network, JUNET. Its role is

similar to Tsinghua University in China. Then, NTT Lab helped them for communicating by a long distance call. At the University Tokyo, Jun Murai and Jun Matsukata realized their connections in Tokyo area. That's straightforward because they used local calls.

How about long distance communications? JUNET used UUCP protocol which uses telephone call at the very beginning. The first stage of JUNET did not use IP protocol. Fortunately, NTT Lab had a big switch. Please note that this switch means a telephone exchanging unit, not a single contact switch. (A switch box?) A telephone switch unit is a very large equipment, which can cover all the subscribers in a whole city. We call it switch, telephone exchanging switch which is very large in size. It is much more expensive compared to Internet routers. We were lucky because there was an experimental switch at NTT Lab, because it was the laboratory of a telephone company.

The subscriber lines had the telephone number as usual. One good thing is there was no telephone charge because it was an experimental equipment for research. One can make a phone call as an experiment. We utilized that switch unit to make our long distance call (Yeah). It was a kind of secret. Now this story is written in Japanese Internet history document.

34:44

FYY : So, uh, could you tell me more about your experience in APNIC

SG: APNIC? As I mentioned, APNIC was first started by JPNIC as a pilot project. Then, US people felt that it's time to ask their friends in Europe, we now call it RIPE NCC, Réseaux IP Européens Network, a French name, and then APNIC to cover Europe and Asia Pacific.

We started a pilot project APNIC in January 1994. At that time, actual activities were taken by Japanese, namely JPNIC. We had already set up JPNIC for Japan. We were also guided by Professor KilNam Chon in Korea. Have you ever met Professor KilNam Chon who is very important in Asia Pacific? Because Professor KilNam Chon was a classmate of Vint Cerf and other people at UCLA. They were affiliated at different laboratories. Prof. KilNam Chon worked for wireless communications and he joined Collins after getting his PhD. Collins was a wireless company.

Collins is now called Rockwell Collins. They are still making wireless equipment for jet fighters, and some military equipment. Collins was very famous for their amateur radio equipment. That is why I know Collins well. Then, Korean government set up a new university. It's called KAIST, K A I S T is Korean Advanced Institute for Science and Technology. Professor KilNam Chon was born in Japan, and graduated from Osaka University. He can speak fluent Japanese. We can easily communicate among us either in English or Japanese. He always watches the global scene. If he notices some US activities, and our European friends move, why not Asia

Pacific?

For a long time, NIC in US was managing the IP address space. It was a US activity, which covers North America because it covered Canada and Mexico as well. Latin America came later than Europe. Then, Asia Pacific followed by Africa.

Now we have five Regional Internet Registry, including LaNIC Latin American, and also AfriNIC Africa. We started with three, North America, Europe, and Asia Pacific. When we started three RIRs, our US friends felt that maintaining a huge size database for IP addresses is not so easy.

Let's divide the database into three. North America, Europe, and Asia Pacific. After we started the pilot project of APNIC, we received the data from US, which was only one central network information center. We tried to cover our region, Asia Pacific. This pilot project was quite successful because we realized a quite stable operation. We, JPNIC, called help from Korean friends and Thailand friends to help us. At the beginning, a large number of records were allocated to Australia. We talked to them. We were happy to hold the very first meeting of APNIC in 1995. It was one year later than starting our pilot project.

At the first APNIC meeting, I spent some money to support our friends. I asked our friends, “please write a report on the Internet in your country, and make a trip to Bangkok.” I believe this scheme helped our friends to attend the meeting, especially for our southern friends. Air fare for a shorter

distance is not so expensive. Their reports on their country were useful to us to know the Internet circumstances and issues, how they are using, how to develop their network. We tried to be a real network information center who has the proper information about our region. That was the story when we started APNIC.

Now APNIC's role does not cover everything because there are many, many Internet related organizations. However, at the very beginning stage, APNIC is the only one organization which covers all the Internet activities in Asia Pacific region. (yeah) For example, if one wanted to get an IP address block, there is no other way than to get it from APNIC. If you would directly contact NIC in US, they redirect your request to APNIC. APNIC is the only one authorized organization in Asia Pacific.

40:01

FYY: And for the APNIC And, I think from my information, the initiator is Toru Takaishi?

SG: Mr. Toru Takahashi played an important role in Asia Pacific. Which organization you are talking about, APNIC?

FYY: APNIC. He used to be the president of APNIC.

SG: At APNIC, he was a chair of the executive committee, not the president. Perhaps, you are talking about IAJ (internet association japan) or APIA (Asia Pacific Internet Association). Anyway, he played the major role actually. He's the first Inductee to the Internet Hall of Fame, Internet Society. They count over one hundred inductees, but he's the very first one from Japan.

And he contributed to the business community. Prof. Jun Murai moved from Keio University to Tokyo Institute of Technology and then to the University of Tokyo. Finally, he was back to Keio and became a professor at Keio. He continued to be affiliated at universities. I was working at NTT Lab. I was a researcher or scientist at a telephone company, and I moved to Waseda University as a professor. So my career is not limited in university, but it is in research or development community in the broad sense. On the other side, Toru Takahashi graduated from Tohoku University and having some literature background. And he made an organization, Internet Association Japan and also helped people to setting up similar organizations in Asia Pacific region together with Prof. Haruhisa Ishida.

Once, Toru Takahashi was the CEO of an ISP, internet service provider, that was called Tokyo Internet established in 1994. The company is not existing now. Tokyo Internet had support from SECOM. SECOM is a security company in Japan. Afterword, PSI purchased the company in 1998.

A similar story happened in Korea. Namely, the originator of the Internet business is acquired by the same US firm, PSI. It's a very US way of life, just common in Silicon Valley. The founders have alternatives. Is it better to keep their business by themselves or just to sell it to another big firm? It's a choice. In fact, Toru Takahashi is senior to me at my middle school and high school. (Really?) However, there is a gap between our ages. I did not know him when we were students. Now, I can find his name in the list of alumni association of those schools.

42:53

FYY: so, uh, you've mentioned that uh, in the development of the Japanese Internet. Oh, you got a lot of help from other companions from Thailand, Taiwan. So do you think that's a result of the group efforts?

SG: Yeah, that's right. I already mentioned that at the very initial start-up process of the Internet at NTT Lab, I had been helped by many friends. For example, Cisco helped us to modify their software. Also, we had a good achievement in multilingual use of the Internet. Fortunately, I had talented good colleagues at NTT Lab. The first successful web is browser is called “Mosaic”. It came from NCSA, National Center for Supercomputer Applications, the University of Illinois at Urbana–Champaign. At NTT Lab, my friends, three of my younger friends, Hitoaki Sakamoto, Toshihiro

Takada and Shinya Sato, made it international. That is, they made the Japanese version of Mosaic. And beyond that, it’s not only a Japanese version, but it can easily cover other languages. Namely, Korean version, and Chinese version are available at the same time. Chinese version for GB coding, big five for Taiwan, it is easy to be international because they designed the browser on multilingual technology. It's very helpful to many users.

I mentioned many names at NTT Lab, Yasuki Saito, Ken-ichiro Murakami, Hitoaki Sakamoto, Toshihiro Takada and Shinya Sato. They are all younger than me. Since I was senior to them in a research group in a company, I should represent this group. It is a Japanese way for the most senior person to represent a group and he should explain what we are doing because we use the telephone switching unit for free. I explained such and such. There was an episode of international calls. We needed to call US because UUCP link uses telephone call. There are already some users. For example, one of my friends wanted to communicate with his friends at MIT. I needed to communicate with my friend at Stanford. The domestic phone call was okay because it used an experimental switching unit that we could use for free. However, international calls were not handled by NTT. There was another company, KDD, who deals with international telephone calls. We paid quite a lot to KDD.

Then I was called by the accounting division at NTT Lab, and they asked

me why I was spending so much money for international phone calls. I explained that it is much cheaper to use e-mail communications compared to a business trip to Geneva Switzerland to attend some standard committee. Travel expenses are expensive. It is more than the international telephone call charge. If one can communicate with people over the Internet, there's no need for the trip. The cost for only one trip covers our monthly charge for international phone call. I could successfully persuaded the accounting division. However, a couple of months later, I was called up again by the same division. They remembered my explanation that we could decrease the number of business trips. However, after we introduced the Internet to NTT Laboratories, the number of business trips was increasing. Then, my explanation was not right. I explained another logic. When you receive an invitation letter via physical mail, oops the deadline is over. However, if you receive it over the email. Okay. You can go immediately. The activities of the laboratory increase and it's very good. I explained it to higher ranking people at the meeting about spending much money for international telephone calls. They laughed at me. They call me a kind of liar. However, they approved my expenditure. Until then, some people had started using the email communications for managing the activities of research and development. After the above explanation, the accounting division was willing to pay the telephone charge. Many people helped us because the Internet was new and they experienced very visible effects, just like a

business trip.

47:22

FYY: Okay, so you mentioned that the…… You mentioned multi-lingual domain name. So uh, how did that come into your mind about to make it?

SG: I already mentioned multi-lingual treatment at web browsers. The multi-lingual domain name is a separate topic. The multilingual domain name was again a collaborative work. It was first proposed by my friend in Singapore, Dr. Tan Tin Wee. (We just interviewed him) Oh really. I know Tommy Chen, he's a real father of the Singapore Internet. After Tommy Chen moved from the unit in NUS, Singapore, to start his business, Dr. Tan Tin Wee took over Tommy's role. He's a very good person. We know there are four official languages in Singapore, English, Chinese, Malay, and Tamil. Every official thing in Singapore should be written in 4 languages, if you really need an official one. It's very natural for our friend in Singapore to realize, not only English, multi-lingual domain names. We had a good chance when Dr. Tan Tin Wee visited Osaka in Japan. We had an APAN conference in Osaka, and we asked him to visit JPNIC office in Tokyo to explain his idea to us. After we listened to a talk from Dr. Tan Tin Wee, most of Japanese friends just support him. However, there were some reservations. For example, if we use Japanese domain names, our friends

in Europe cannot display Chinese characters properly on their screen. The Japanese domain name looks something random or cryptic. So it's useless to adopt multi-lingual domain names.

On the other hand, our friend in Taiwan claims that English ASCII domain names are OK for young people, while senior people or school kids need their own local language representation. After some discussion, we decided to seek the standard representation of multi-lingual domain names. Again, I had many, many friends who were willing to work on it. Especially, Mr. Yoshiro Yoneya, who is working at JPRS, played the major role in the standardizing process. He made a very useful evaluation kit for different encoding schemes. Because the number of Chinese characters is really huge. (Yeah.) If you look at a character table for Chinese, you need a magnifier to read a specific character. We certainly need an automatic tool for table look-up. It is useful to have a tool when we have some idea and want to test it immediately.

They came up with Punycode that is the Internet standard now. As a result, Japanese contribution was providing the evaluation kit as a software. We could fixed how to manage the second level domain names. We have Japanese characters followed by .JP in Japan. Korean characters followed by .KR in Korea. Chinese characters followed by .CN in China. We allow some local rules in each country, because some names should be protected, not used for free. For example, we have some designated names as reserved

in Japan. The reserved name is not usable. For example, the name of an elementary school was reserved because some malicious guy might make up some fake website and use the domain name officially. It's a real domain name, and the school kids may be attracted by the malicious person.

We tried to avoid the popular name or the organization name of either central or local government, because they can attract many people. It's applied to the names of international organizations. But we recently allow the names of elementary schools, middle schools and high school names for registration. In ten years, we carefully observed who are doing malicious things, etc. We have enough experience now. The real tough issue is how to deal with top level domain names, not under CN or JP, in multi-lingual format. There should be some global standard rule to settle it. We are discussing the standard or guideline for the multi-lingual top-level domain name which can be used globally. It’s necessary to talk to ICANN. We already spent three years. There is a rough consensus among us, China, Korea, and Japan. We also include Taiwan, Hong Kong, and Singapore, who use Chinese characters as well. We should explain our idea to ICANN. Some of our friends in Europe understand our discussion because there are some modification for English characters. In French, there are cedille and accent symbols. In German, they have two dots umlaut. In Sweden or Norway, there are some characters not included in US ASCII. However, thousands of characters in Chinese is beyond their imagination.

We basically came up with a common understanding among us. Still, it will take more time to explain it globally. If somebody does not know Chinese characters well, he may feel that many characters are visually similar. On the other hand, we, Japanese and Chinese, can distinguish subtle differences between visually similar Chinese characters. Then we propose to keep the original characters as far as possible. But from their point of view, it's dangerous to allow the visually similar characters to be allocated independently as domain names. There is a risk of phishing or fake websites which look similar to the legitimate domain names. From their point of view, some characters are visually similar, and from our point of view these characters are different. We, Japanese and Chinese, know the meaning of each Chinese character and we understand the shape of each character individually.

(So very long time) Yes, very long time. I mentioned the contribution from Mr. Yoshiro Yoneya who is now at JPRS. JPRS is a company for domain name allocation and management that is a split off from JPNIC. At JPNIC, we divided our activities into the IP address allocation and the domain name management.

When we split old JPNIC into new JPNIC and JPRS, we thought that most countries will follow our Japanese model. However, Japan is perhaps only one country who divided the responsive body into IP address and domain name. The reason for us to split our jobs is because the size of the operation

is different, domain name management is much larger, four or five times larger than IP address allocation.

We thought that we need a commercial company for domain name. Still a major portion, namely more than twenty percent of the JPRS stocks is owned by JPNIC. Even though JPRS takes a form of a commercial company, or a private company, it still plays a special role for the Internet. So it's a specialized company, not a profit-seeking company. (Yeah, I see.) JPNIC itself is a non-profit organization which is officially registered at Japanese government.

55:12

FYY: and I see in my file here. Uh, you were selected as the chairman of multilingual internet names. And for the Internet and makes multilingual domain name to the internationalized domain name. And so I think it must be quite hard, uh, compared to that the multi language be accepted by Europeans.

SG: That's right. I was the chair of MINC who dealt with the second level domain name, not the top level. As I mentioned, we came up with a standard successfully. The coding scheme is called PUNY code. P U N Y is a modification of UTF-8 unicode.

If you translate a Chinese character string into UTF-8, it becomes longer.

It's not good for computers to deal with a longer domain names, because there are certain restrictions of the length of the domain names. As I mentioned earlier, JPNIC friends made an evaluation kit to test and compare many, many proposals technically. Finally, they came up with the PUNY code. Even though our screen cannot show the proper surface level font sometimes, there is the standard internal representation of the multilingual domain name. Even if I cannot show a Chinese domain name properly on my screen, I can use it to my friend in China. Their screen properly show the Chinese domain name. The most important thing is to have a standard, otherwise encoding schemes are different in China and Hong Kong. When the coding scheme is totally different, it's very, very hard and confusing.

We were happy to come up with a standard, It's a Unicode based PUNY code. My chairmanship just covers only one year. Even at that time, we explained our idea to our friends in Arabic countries and also European friends. Our European friends supported our idea, because they need some French words and German words as I mentioned. It’s not US ASCII characters. In the northern part of Europe, like Sweden, their character sets are larger. Slightly larger than English. It is not like Chinese which has thousands of characters. Still, they are quite supportive to us.

Using English ASCII for domain names is okay. There is an established global standard for domain names. There is no misunderstanding. If we

would introduce multi-lingual domain names, it's very good for local people who speak that language. And sometimes it is not good for other people, because they cannot read that language. (Recognize the characters?) If there is no fonts in your computer, there is no way to display them on your screen. Nowadays, the current version of Microsoft Windows or Apple OS have a wider coverage of languages. More than thirty languages are build-in usually. But when we discussed the issue of multi-lingual domain names, the coverage of a standard computer was poor, just English and one local language. For example, if you purchase a PC in China, it has English and Chinese. If you purchase a PC in Thailand, it has English and Thai language.

Reaching a common understanding is not so easy. For example, when Arabic characters are used for a second level domain name, most of us cannot read it properly. On the other hand, as I mentioned before, we have something which is difficult to be represented in US ASCII, and well represented in Chinese. If you have something in Chinese characters, it’s naturally represented in China. However, if you use US ASCII for “Pinyin”, there is some ambiguity and more than two words may look similar without “Sisheng”. That would confuse people.

In these cases, we certainly need the domain name in local language.

FYY: ok, That's hard progress.

60:07

SG: During our discussion, some of my friends were against with me. They asked me if I want to divide the Internet into smaller pieces that are covered by each local language? I said No, it is not our intention to divide the Internet. We just offer an option to use either English or local language. Actually, the local language has been already used in our website text and e-mail messages. As I mentioned earlier, the web browser is already internationalized. You can read a web page in Chinese character, while my Japanese PC may have a problem in displaying it.

We have already established the standard for multi-lingual texts. Then, there is a way to investigate multi-lingual domain names, because we can have tools if the standard is established. There should be no confusion.

FYY: So we want to thank you for your efforts on this multi-lingual so we can use our computer language…

SG: Before we established the standard for multi-lingual domain names, there was a need for non-English communications at the very beginning point. When we started JUNET in Japan, we wrote email messages in English or Romanized Japanese transcription using US ASCII.

The Romanized Japanese has a couple of standards and therefore confusing.

We can type in Romanized sentences fast, but read very slow, because it represent only the pronunciation. Sometimes, we cannot guess the original Chinese characters from their pronunciation. We really needed Japanese characters for smooth communications. There was a very interesting story when we started JUNET. At first, we used English only or Romanized ASCII characters. Then, we gradually introduced Japanese character fonts. There had been a controversial matter or battle between two professors in Japan. They were fighting each other for some issue over the net news. Net news was a widely circulated bulletin board on the Internet.

We called their fight as an electric quarrel. The discussion was heated up after we introduced Japanese representation. Many people felt that the electric quarrel is not a proper use of the Internet. It was against the code of conduct. However, I thought somewhat differently and I persuaded my friends. The electric quarrel is a very good example because the fighting friends can express their emotional things in Japanese. That's definitely the proof that the Internet is quite useful. (Yeah), You can communicate with your friends with your emotion. It realized quite high-level communication. The Internet is quite useful for us, definitely.

1:02:57

FYY: Yeah, sure. And how do you think about the Internet development in Asia pacific? Because, as you said that, the Internet was built by the joint

effort from the whole region. So what do you think of Asia Internet involvement in the Internet governance.

SG: Oh, are you talking about the Internet governance? You mean talking about ICANN. (Um, yeah) We have not come up with a very clear idea of the Internet governance yet, because it's totally different from the established telephone system. In telephony, there is an organization, ITU. It's just an organization under United Nation. In United Nation, each country has one ballot or a vote, even if some countries are small.

If you successfully collect many ballots at ITU, then you will win. On the other hand, decision making in the Internet is not so easy. We respect the consensus among us. Even if we have ICANN, it is not the final goal for us, because ICANN is a challenging new model. It tries to avoid US centric. Decision making at ICANN is slow. For example, every time we set up a new committee, we spend quite a lot of time, like three months or half a year or more to set up their own management rule. They should fix who can be a proper member, who can vote and who is responsible for what, whom to report to, et cetera.

It means that the organization, the guideline or rule are not well developed yet. It's a quite an exciting challenge, because there are many people using the Internet and the government control is strong or weak. In China, Chinese government thinks it's their responsibility to keep the Internet

stable. In Japan and UK, they keep their intervention at lower level.

Then, the Internet governance in each country is totally different. The tough question is how to come up with a global structure and the group of guidelines.

I think it's a challenge for all the human beings because we cannot keep our living without the Internet. There may be a big change, just like a protocol change from NCP to TCP/IP in the earlier days of the Internet. Even the popular TCP/IP may not be enough in the future. It cannot last for a long time. Still it is very important to keep the global Internet. We surely need the Internet, even though we may change the technology. To keep the Internet is not so easy, because, as you mentioned, the Internet governance is essentially a human activity. We do not have a trivial answer to how to reach our common goal. For example, if the current TCP/IP is not good, then when and what change we should make. We should come up with a single solution globally. When the pioneers experienced a big change from NCP to TCP/IP protocol, it was done only in the US. And the number of connected hosts is like five hundred or one thousand. Still, it took half a year to complete the transition. Now, the number connected hosts is really huge. Fortunately, there are many people operating the Internet. They have a consensus on the current Internet. It's not possible for small number of people to propose a new protocol and move to it. He or she needs strong support from the Internet community. Otherwise they should not change

the protocol. If the proposal is new, it should be tested or evaluated. We should discuss what is the merit, the pros and cons. Many people join the discussion. It will take some time to come up with the real, fancy global Internet governance.

1:7:58

FYY: Yeah, it’s really hard to get in a common idea about how it should be change into.

SG: Our experience in the domain name shows the importance to have a common understanding to establish a standard. And then on top of the standard, each country or region or either a company or organization can put their own guideline and add their own technology if they like. It's a kind of option. So the standard does not cover the total features. It's almost impossible to make the whole perfect design. It's better to ask the community to complete the global map, not rely on a small number of people.

I believe that we have enough good experiences in standardization, which are illustrated by the multilingual domain name.

1:9:4

FYY: and how you think the Internet development of trend, how the

internet for the future?

SG: I think a very important technology is blockchain. Many people know bit coin. Bit coin is one implementation of block chain. For some people, it’s a P2P network which is not controlled by the central bank. In some country like China, the government officially states that the government is responsible to have a stable, secure Internet. It is natural for them not to allow anonymous coin. Actually, the technology is not simple. If some digital signature is associated with a real ID like PKI then it's not anonymous anymore.

It's just like a bank bill which is signed by your name, that is your real digital signature. One can get the information who has this money. Perhaps, the real signature is an extreme case. We need some good solution between anonymous and the real signature. We still don't come up with the common standard. It is still controversial.

In block chain, each technical element is well-known or well established. There is no secret. They are explained by introduction level textbooks. For example, we understand digital signature, hash function, and P2P communications. There is no wonder. Still, there are many, many issues, and some bad things happen. Some digital coin was stolen and there are some fake trading. Malicious people try to achieve much faster chain growing, because the longest chain will win in block chain mechanism.

I think it's good to have problems right now before we will have real serious applications. Right now, small number of people have serious problems. For example, one of my friends who is a banker lost some amount of money. (Bitcoin?)

No, it's a kind of blockchain that was accidentally stolen. The management company compensated the loss at the market value. Unfortunately, the market value has dropped. The value was high at the peak time. We do not know whether bit coin or some digital cash will be successful, or it would fail. However, there are similar technologies around. Now, it's a very interesting period. For example, we can apply block chain technology to IP address registration, and domain name registration. It's okay to allocate an IP address and a domain name to your PC or your company server.

The situation would be changed in the area of IoT, because the number of units is huge. Each microphone, camera, your watch is all connected. If you need domain names for them, NIC will be very busy. Perhaps it cannot be handled by a human being. They need a new technology at NIC. As far as I know, two friends of mine have investigated the application of block chain technology to allocate the Internet domain name. There are two projects in China. One is Tsinghua, another is CNNIC which is closely related to Chinese Academy of Science. In both projects, they can assign a quite large amount of domain names in a reasonable time.

The domain name should be genuine, not a fake. Then we need automated

guaranteed mechanism for registration. If necessary, it proves that the registration is legitimate. That's based on block chain technology. This example shows how new technology would change our jobs and social life. It is not limited to the Internet management. For example, Japanese Ministry of Environment called for proposals of how to maintain the CO2 control database by block chain mechanism. It's still in a research phase, but they are seriously investigating block chain mechanism for their database. Should we move into new technology or it's not time to change and we still need to keep our old fashioned database for some time? It’s a very good question. We should compare new technology and the old technology. New technology may or may not change almost all aspects of our social life.

1:14:27

FYY: And so you really think that block chain is the future?

SG: Yes, it’s a topic we should investigate right now. And we should understand the current Bitcoin is one example. If Bitcoin fails, there are other technologies around and already some researchers are trying to apply them to DNS registration. It may change our jobs in JPNIC, JPRS, and CNNIC. But no one knows how it would happen. So it's worthwhile investigating.

Let's us investigate new technologies together. And we would have a common understanding, at least. And if possible, we establish a standard platform. Beyond the standard, it's a free competition. This kind of race is okay.

FYY: So what do you think about artificial intelligence because you`ve worked in that field for one year…

SG: Are you asking my comment on artificial intelligence today? The topic is outside of my sphere, but I will talk some comments. The current artificial intelligence technology is based on the statistics. No one knows the future in general. However, the near future is usually just similar to the immediate past. Then, we can forecast something.

If today is a rainy day, then I would tell it will be rainy tomorrow. If the weather is fine today, it will be fine tomorrow. My forecast is more than fifty percent correct according to the statistics. This kind of technology is used. For deep learning, we need data. Then, based on the data, we predict the near future for a short time period, not a long forecast. If most environment is kept the same, then you can guess the future. A computer may perform much better than a human being. A human being has certain limitations. One cannot handle many things, say twenty things, at the same time. The human brain usually can memorize seven (things) at the same

time. There is a limitation. It is a natural limitation over the structure of human brain. For a computer, the volume of twenty is no problem. For a computer, twenty thousand is very easy. There is no way for a human being to compete with a computer. For example, human beings are weak at pattern recognition of hundreds characters. Performance of artificial intelligence is much better than a human being. The first issue is that deep leaning is called a “black box”, because deep learning does not explain the reason when the black box gives you a result. If you ask why it gives the result, there is no answer. We need some explanation, because a human being wants to understand semantics or the meaning of the result. We are not satisfied with a black box. The second issue is that all the assumptions are changed when we have a sudden change. Then, the past data is not useful. It is based on the huge amount of data which is compressed into a matrix and wait for the learning calculation.

That shows how to use the current technology and forecast the future for a short time. The proper usage is just to apply it to a stable data, like handwritten characters. If you observe people's writing for a hundred years, there may be little change over the period, basically almost the same. If you can select the application area, you will be successful. So we need a proper usage of artificial intelligence.

Sometimes we cannot understand why the result came out through artificial intelligence. As I mentioned, human brain has certain limitation. It's far

difficult for us to understand many things at the same time. It's the limitation of our intelligence. If you try to compete with a horse or cow for physical power, we will be defeated. And we cannot fly. We, human beings, should understand our natural limitation of our brain, muscle, anything. The same consideration is taken for the applications by artificial intelligence. It's already used in face recognition. It does not attain one hundred percent perfect, but it has been used for our daily life already.

1:20:4

FYY: Yeah. So in your opinion, eh, a human mind is not so complete compared to the artificial intelligence, there's so much limitations. So you think the AI will finally help a human being?

SG: Yeah, we already have help from artificial intelligence, for example a human medical doctor may be exhausted by scanning suspect data to find cancer cells. Artificial intelligence would help to find suspicious one. The medical doctor can put his limited energy into other areas, like filtering. This kind of technology is already used.

Still, tt's not possible to replace the human brain by artificial intelligence, because we don't have any technology for such kind of integrated artificial intelligence. It's called strong artificial intelligence. We now have weak artificial intelligence which is used for specific areas, like face recognition,

handwritten character, speech recognition, and language translation. In such established areas, if you supply enough data, artificial intelligence will do much better than the average human. We have some specialized human experts. However, the number of specialized experts is limited. Applying artificial intelligence, we can make a copy of a human expert. It is necessary to have big data centers who collect big data and input to machine learning..

1:21:52

FYY: Don't you afraid of that? AI will compete, will beat human being?

SG: I do not believe that AI will beat human being, because there are some jobs and tasks which cannot be replaced by artificial intelligence, for sure. So it's time for human being to think what we should do. Perhaps human being should do more creative things. For example, our future vision is not simply based on the old data. That’s beyond learning mechanism by artificial intelligence. We can prepare and respond to a sudden change which is not learned through old data. That kind of things are still the weak point of artificial intelligence, because the current technology is based on old data, and previous experiences. There is a certain limitation for artificial intelligence.

1:23:4

FYY: And now there are some questions about your relationship with China. And when did you first come to China?

SG: Perhaps it was 1993, I think. I first visit China in 1993 or 1992.

FYY: OH, it's quite early?

SG: Yeah, at that time there were some activities in Asia Pacific. Before APNIC, we founded APNG. That was only one organization in the Internet in Asia Pacific region. Perhaps it's 1993. I should refer to the web page of Asia Internet History Project edited by Professor Kilnam Chon. I remember the very first stay on campus guest house of Tsinghua university. I don't know if they still keep the facility or not. At that time, the Internet is not for every citizen in China. And I remember the air pollution was very bad during our stay in Beijing. We could smell coal burning. Today, the air condition is very good.

FYY: Air pollution in 1997? (1993) 93, yeah,

SG: Much improved. (compared to before) compare to the very first visit to Tsinghua University. This week, I can enjoy blue sky. (okay). After

Beijing meeting, we hold the meetings of APAN in Shanghai, and Xi'an. We hold meetings in Hong Kong as well. Last August, we hold our APAN meeting in Dalian. So I visited some cities in China, but my visits are still limited to big cities.

FYY: So you've been to many places of China.

SG: Um, Geographically, Yes.

FYY: So what's your impression about these places?

SG: Every time I visit China, I feel that it's developing, changing, and growing, you utilize the power of the network.

FYY: Yeah, So what do you think about the development of Internet in China?

SG: As I mentioned, the number of users is quite huge in China. Then, you deploy IPv6 well. It is a good example of China as a front runner of new technology. You can tell your lessons from your experiences to the world. As for IPv6, our friends in US have a huge block of IP addresses, they have less demand for IPv6. However, in growing countries, they surely need

IPv6 address spaces. As I mentioned at the topic on IoT, the IPv4 addresses are already exhausted.

So there's no way other than utilize IPv6. China's achievement is really a good example. In the current data science or artificial intelligence, we really need the data. For example, if we have the real traffic data of a network, we can tell whether people are satisfied with the network performance, or there is any room for improvement, etc. In Asia Connect project, our friends in China are managing the Network Operation Center. They observe, analyze and investigate traffic data through router or switch ports. That's really requested by the global community. Our Chinese friends are doing quite well. And I hope they continued their work. (efforts)

1:26:59

FYY: So do you have any suggestions to China?

SG: In the Internet governance, we usually discuss the management structure. But at the same time, we discuss cyber security and also privacy or copyright issues. I understand that Chinese government has comparatively more power over the Internet. Other countries like Russia, take similar or the same approach. They’re learning from Chinese experience. It's a different style from UK and Japan.

However, Chinese companies or manufacturers, or service providers will

seek the global market. It is desirable that Chinese university student would learn how the other countries' disciplines are, for example personal data protection. China as a country is quite sensitive to keeping data. (Yeah) Other countries, like European countries, are quite sensitive to personal data as well. Their scheme is somewhat different from Chinese. If Chinese people want to be global, then you need to learn other countries. Those who already learned should teach young people to bring them to global citizen. You already know this is the discipline in China and that is the discipline in Europe. And this is the discipline in US. Some Latin America countries may take somewhat different approach and Chinese people would know how African countries show some diversity.
Then that would be really the contribution from Chinese people, Chinese company, or Chinese university to the global community.

FYY: So you think that we should go abroad to learn all this,

SG: It is a good idea to invite some experts who know global scene quite well. Then China can play the real global role for the Internet development, because you have already developed it.

FYY: Thank you very much. And I think almost time actually. could you write something for our project?