Survival from 3.11 Great Tohoku Earthquake Disaster
~We have resumed research activities~

Introduction

The earthquake happened at 2:46 pm on 11 March (Friday) 2011 is the biggest one in the last 1,000 years and the succeeding devastating tsunami of height of fear attacked the northeast (Tohoku) coast region of Japan including Sendai. The scale of this tsunami was the first time to happen since the Jogan tsunami happened on 9 July, 869.

The earthquake of 11 March brought serious damages to the no.1 faculty building (Fig.1) of Electrical and Communication Department, Graduate School of Engineering, Tohoku University, standing on the top of Aobayama hill, located in the west of Sendai’s downtown. A total of around 20 research laboratories in the no.1 faculty building were forced to be relocated. A number of students of our research laboratory formed a volunteer group to relocate our research laboratory. Thanks to the student volunteer group’s great effort, we successfully resumed the research activities within one and half months since the earthquake. Our struggle in the last two months will be reported here.

The earthquake of 11 March seriously damaged the mobile communication networks. Therefore the development of communication networks which is robust against such a regional disaster is necessary. And my thoughts on the future communications networks will be suggested.

Our research laboratory damaged by earthquake

In the Aobayama campus of Engineering, three buildings including ours were seriously damaged and it is decided that they have to be rebuilt. Our faculty building of 8 stories was more intensively damaged on upper floors. And the adjoining lecture buildings were also partially damaged. Fortunately, the date of 11 March was in our spring holiday period and no students were injured. The bronze statue of Prof. Yagi, an inventor of the Yagi Uda antenna, in the courtyard (Fig.2) was safe.

Tohoku University delayed the start of spring classes to 9 May.

Earthquake and laboratory relocation work

The earthquake came immediately after we started our laboratory seminar. We heard the earthquake alarm “An earthquake of four in the seismic intensity will come 5 second later, 4, 3, 2, 1”. The countdown was very accurate; however, the seismic intensity level was not 4 but 6. The strongest shake continued for about two minutes and become weaker. It continued for about six minutes in total. We felt fear and couldn’t make moving. After the earthquake, all of us were able to evacuate to the outside safely. It started snowing after the earthquake. However, it became fine weather in the evening, and the moon and stars looked beautiful. I thought it was something mysterious.

Supply of electricity, city gas, and tap water has stopped immediately after the earthquake. It took almost one month to resume the gas supply while electricity and water services resumed in Sendai downtown after one day.

Our research laboratory rooms were devastated (Fig.3). It turned out that the building structure housing our research laboratory was damaged too seriously and as a result, it was decided to be rebuilt. And we had to relocate our research laboratory. Our research laboratory formed a volunteer group of 7-9 students and started working on 23 March (Wednesday) from putting away scattered books, fell down computers and bookshelves.

It was the end of March when we started the relocation of our laboratory. The new location of our laboratory is in the no.2 building next to no.1 building. Thanks to the student volunteer group’s great effort, the laboratory relocation was completed successfully in less than one month from the earthquake (Fig.4).

A big aftershock happened on 7 April and devastated again our new laboratory which was close to completion in setting up (Fig.5). Although the student volunteer group had to restart putting away scattered books, fell down computers and cupboards the second time, our laboratory relocation was completed in the middle of April after their hard working.

Fig.1 Damaged No.1 faculty building.

Fig.2 No damage to bronze statue of Prof. Yagi.
In our student volunteer group, there are students who stayed in Sendai and did not return to their hometowns and also one student commuted from Yamagata. It is recently said that younger generation does not have the spirit of helping. However, looking at our volunteers’ wonderful work, I am proud of them who, I felt, have the spirit of helping and the strong passion into research. The student volunteer group overcame the earthquake of 11 March and its aftershock of 7 April and succeeded in relocating our research laboratory into the no.2 faculty building. Our students of Tohoku University are strong in a disaster.

The international students were worried about the radiation poisoning caused by the nuclear power plant accident after the earthquake. They returned home, but started to come back to Sendai in middle-April. By the end of April, most of our research laboratory members gathered again and resumed our research activities.

Finally, long-awaited laboratory activity resumed. I was very happy to see smiles of laboratory members (Fig.6). We held a laboratory seminar on 25 April (Monday) for the first time after the earthquake of 11 March. A PhD doctor course student who was supposed to present a paper this May at an international workshop in Germany did a presentation rehearsal.

25 April was the date when Shinkansen resumed its operation between Tokyo and Sendai.

**Robust communications networks**

The earthquake of 11 March caused a monster tsunami which can happen only once in 1,000 years and badly devastated the Tohoku coast region. Experiencing such a regional disaster, I strongly felt that securing the communication to confirm the safety of family, parents, relatives, and colleagues is the most important. Wireless communications should have demonstrated its potential at such a regional disaster. However, the communications equipments were damaged by the earthquake and the succeeding tsunami and furthermore, many base stations of cellular systems lost their power supply. Moreover, a concentration of communication demands led to a very low probability of a successful call.

People want to make a real time conversation in the disaster. A communications network needs to be developed that can provide real time conversation to people as many as possible at the same time, e.g., one or two order of magnitude increase in the link capacity is necessary. However, the available wireless bandwidth is limited. Very low rate voice codec and resource allocation method are an important research topics for extremely high-order wireless multiple access. It is desirable to develop a flexible secure power supply network, cooperative communication between terrestrial and satellite networks, and furthermore the stratospheric platform.

**Conclusion**

I am very proud of the student volunteer group of my research laboratory who did wonderful work at the disaster. I am very glad to be able to resume the research of advanced wireless technologies with those students.

The earthquake of 11 March gave us an important chance to reconsider the direction of communications networks development. It is a quite difficult issue how to realize a cost efficient communications network while robust against a rarely happening (e.g., once in 1,000 years) disaster. We want to share with our friends our experience of the disaster caused by 11 March earthquake and tsunami, and work together towards the new communication technologies and networks.
We received a pile of emails of worry, encouragement, and offering of help from worldwide. We would like to express our heartful thanks to those who sent emails. We successfully relocated the laboratory and resumed the research activities at the end of April. Tohoku University survived the disaster and is going on!

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