Abstract—The rapid development and widespread application of Internet has provided a platform for people to participate and discuss social hotspot events. In the meantime, emergency events have attained more attention and have been spread more quickly than they did ever before by this way. However, the public opinion on Internet usually exerts a heavy impact on the development of emergency events as well as the social psychology. This paper presented a cycle model to describe the Internet spreading process of emergency events, and applied the Tobit model to research the influence factors in that process. After analyzing the social psychological impacts, a life-cycle emergency management methodology and the related strategies were proposed for the achievement of healthy spreading environment on Internet.

Index Terms—emergency event, Internet spread, psychological impacts, emergency management

I. INTRODUCTION

The popularization of Internet has led to the fact that news can be published and shared at any time and place, and has become the first choice of channel for the public to have discussions and make comments. Emergency events have been known more quickly and attained more attention than they did ever before. However, the public opinion on Internet usually exerts a heavy impact on the development of the emergency events as well as the social psychology.

So far, scholars have made a large number of researches on the Internet spreading mechanism, netizens’ psychology and their behaviors.

On the aspect of Internet spreading mechanism, J. Zhang[1] and L. J. Jiang analyzed the formation process of Internet opinion. W.H.Wei[2] and L. Wang[3] illustrated the impacts of Internet opinion from both the positive and negative sides. X.F.Hu[4] established the small world network model that realized the regional simulation of Internet opinion. And L.Y. Li[5] presented the cellular automata model to analyze the specific factors’ effect on Internet spread. Y.C. Liu[6] later built an agent-based Internet model, working out the different reactions of individuals that play the different roles in Internet spread of emergency events.

On the side of the social psychological impacts of emergency events, G.H. Guo, H.Y. Bi, Y. Hu, etc[7]-[12] have made significant contributions to some special phenomena on netizens’ behavior in emergency events, such as the opinion leader, group polarization, and network violence, etc. Y.M. Liu, Z.R.,etc[13]-[15] concentrated on the public psychological impacts of emergency events and achieved some results in social psychology formation mechanism, changing features, impact factors, etc. Q.L. He, A.B.Zhou, etc[16]-[18] pointed out the psychological impact mechanism and several psychological intervention modes.

Aiming to explore the systematic and dynamic Internet spreading mechanism of emergency events as well as their psychological impacts by that spread, and provide a practical methodology for the emergency management, this paper presented a cycle model to describe the spreading process, and applied the Tobit model to research the influence factors in that process. After analyzing the social psychological impacts, a life-cycle emergency management methodology and the related strategies were proposed for the achievement of healthy spreading environment on Internet.

II. INTERNET SPREAD OF EMERGENCY EVENTS

A. Internet Spreading Cycle Model

The basic composition of Internet spread of emergency events are the information source, spreading platform, and the participants. The information source can either be the Internet itself or be the traditional channel, but both spread through the network platform. The spreading platform ranges from the major media network, such as portals, network forums, to blogs and various social media networks, etc. The participants of Internet spread are usually the netizens, which can be furtherly divided...
into controller, opinion leader, follower and observer. They play the different roles in that spread.

The Internet spread of emergency events is featured to be anonymous, technically versatile, and very fast. It is the major reason that netizens’ identification is unknown, which leads to the wide popularization and heavy impacts of the emergency events on Internet. The technical versatility, consisting of words, pictures, video and other forms, is another feature of the Internet spread that makes public favor of such way of taking in information and expressing opinions. Besides, the Internet spreading scope and influences are used to being magnified in a shortest time because of the technological reason. Last, opinions appear complicated and hard to distinguish on the Internet because its spread lacks a regulated spreading procedure.

Concerning to the Internet spreading process, this paper has referred to the corporation crisis life-cycle theory presented by Steven Fink[19], who divided the corporation crisis into five stages of incubation stage, outbreak stage, diffusion stage, decaying stage, and aftermath stage, and formed an Internet spread cycle model of emergency events as figure 1.

As the model shows, the whole Internet spreading process of emergency events can be divided into five stages: the incubation stage, the outbreak stage, the diffusion stage, the decaying stage, and the aftermath stage. The spreading scale and influences are different among each stage. In the first stage of incubation, the emergency occurs and affects only the related persons because it has not been spread around. In the second stage of outbreak, the information concerning the emergency is published on the Internet and gets some netizens’ attention. In the next stage of diffusion, the information about the emergency gets forwarded and commented in large number of times, accelerating the spread of opinions. In the forth stage of decaying, the emergency comes to the end and the opinions decrease to the least. In the final stage of aftermath, some long-term social effects still exist, for example, the Internet popular phrases, the new regulations, etc.

B. Influence Factors
As it has been pointed out in the cycle model of the Internet spread, the prevention of information spread should be started from the period of opinion outbreak. In order to take the Internet spread into control, we use the Tobit model, which was presented by the American economist James Tobin in 1985, to calculate the extent of different key factors of the emergency events that may cause the netizens’ attention. In Tobit model, the explaining variables are observable while the explained variables are able to be observed in a restricted range.

With this model, we firstly selected some variables and quantitative measuring method, and collected the sample data from major websites and forums, calculating their involvement values. After that, we found out the relevant factors of netizens’ involvement level, using a group of influencing variables to make regression, and figured out the major influence factors of Internet spread.

The model variables we selected can be listed as Table I.

<table>
<thead>
<tr>
<th>Variables Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>BBS Type</td>
<td>1.hot forums 2.potal sites 3.major media network version</td>
</tr>
<tr>
<td>News Type</td>
<td>1.fact  2.commentary  3.Inquiry  4.joking</td>
</tr>
<tr>
<td>Visit Quantity</td>
<td>number of post clicks</td>
</tr>
<tr>
<td>News Word Quantity</td>
<td>number of post characters</td>
</tr>
<tr>
<td>Opinion Leader</td>
<td>1 for existing, 0 for none</td>
</tr>
<tr>
<td>Stage of Spread Cycle</td>
<td>1.incubation stage 2.outbreak stage 3.diffusion stage 4.decaying stage 5.aftermath influencing stage</td>
</tr>
</tbody>
</table>

With these variables, we set the model quotation as following:

\[ y_i = \begin{cases} \beta^T X_i + \varepsilon_i > 0 \\ 0, \beta^T X_i + \varepsilon_i \leq 0 \end{cases} \] (1)

\[ y_i = \beta_0 + \beta_1 BBS + \beta_2 News + \beta_3 Visit + \beta_4 Newsword + \beta_5 Opileader + \beta_6 Stage + \varepsilon_i \] (2)
In the quotation, $\beta_0$ refers to the intercept, $\beta_i$ refers to the coefficient to be estimated, $\varepsilon_i$ refers to the differential, $y_i$ refers to the replying number of the $i$th post.

With the software of Stata 9.0, we calculated the relevant coefficients of the influencing factors. The results are showed in Table II.

**TABLE II**

**The Relevant Coefficients of Variables**

<table>
<thead>
<tr>
<th></th>
<th>BBS</th>
<th>News</th>
<th>Visit</th>
<th>News word</th>
<th>Opinion leader</th>
<th>Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
<td>-0.0835</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visit</td>
<td>-0.1286</td>
<td>-0.0107</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>News word</td>
<td>0.0015</td>
<td>-0.1091</td>
<td>0.1541</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opinion leader</td>
<td>-0.391</td>
<td>0.000</td>
<td>0.0007</td>
<td>-0.0999</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage</td>
<td>0.0073</td>
<td>-0.0039</td>
<td>-0.0114</td>
<td>-0.2532</td>
<td>-0.0741</td>
<td>1</td>
</tr>
</tbody>
</table>

According to the results, all the absolute values of the coefficients in the table are below 0.6, meaning that the explaining variables are in small relevance.

Further with the Stata 9.0 and Tobit regression method, we made regression analysis of all 1896 sample data. Table III shows the regression results.

**TABLE III**

**Tobit Regression Results**

<table>
<thead>
<tr>
<th>Tobit regression</th>
<th>Number 1896</th>
<th>of obs</th>
<th>LL 1948.72</th>
<th>chi2(16)</th>
<th>Prob &gt; Chi2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log reply</td>
<td>-226.6416</td>
<td>females</td>
<td>0.0783</td>
<td></td>
<td></td>
</tr>
<tr>
<td>likelihood</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| reply | Coef. | Std. Err. | t     | P>|t| [95% Conf. Interval] |
|-------|-------|-----------|-------|----------|----------------------|
| BBS   | -7.50605 | 2.1949 | -3.51 | 0.001 | -11.79502 | -3.2171 |
| News  | -1.3064 | 1.17304 | -1.17 | 0.231 | -3.10854 | 0.49775 |
| Visit | 0.000979 | 0.00073 | 1.38 | 0.086 | 0.000204 | 0.00175 |
| News word | -6.13193 | 0.20817 | -28.87 | 0.000 | -8.5055 | -3.7583 |
| Opinion leader | 8.508489 | 3.07679 | 2.78 | 0.007 | 2.38316 | 14.6358 |
| Stage | 5.37808 | 1.41681 | 3.89 | 0.000 | 2.5756 | 8.18058 |

According to the results, the factors that pass the T-test are the BBS type, the visit quantity and the opinion leader. For the BBS type factor, the result shows that the netizens’ involvement extent is relevant to the website type. The netizens are more likely to participate in the forums that are closer to the public forum. For the visit quantity factor, its coefficient is close to 0, indicating that the post click numbers have no relationship with the reply numbers. This is because the fact that the overload of Internet information let the netizens pay more attention to the quality of the information. The numbers of post click do not affect the netizens’ involvement level, either. For the opinion leader factor, the result proves that the opinion leader effect is obvious in promoting the Internet spread.

Besides, factors of the news type, of the news word quantity and of the spreading stage do not pass the T-test, indicating that these factors do not have much contribution to the Internet spread of emergency events.

**III. THE SOCIAL PSYCHOLOGICAL IMPACTS OF INTERNET SPREAD**

**A. Impact Cycle**

The Internet spread of emergency events and their consequent opinions have exerted great impacts on the public psychology. As it was pointed out by the Canadian biologist Hans Selye in the stress model, people respond to the emergency in three phases: awareness, resistance, and tiredness. The psychological effects of the netizens that are exerted by the Internet spread of emergency events can also be separated into four stages in accordance with the five stages in the Internet spread cycle model.

In the incubation stage of Internet spread, netizens have an aware response. Since the emergency is still to be proved, curiosity takes place of the expressive comments. In the outbreak stage, the published information is proved and starts to be quoted and the comments are made in a great number. Netizens start to have corresponding psychological response such as panic, angry, etc. The phenomenon of group polarization and network violence become the products of this phase. In the opinion decaying stage, social attention on the emergency begins to decline and netizens start to be tired of the opinions as well. In the last aftermath stage, comments and conclusions are made by netizens as the emergency comes to an end. Netizens’ response level also gets adjusted to the normal level.

To make it short, the Internet provides a dynamic platform for the public to express their opinions actively, and increases the possibility that the public may be misguided. Reversely, the large-scale Internet spread and opinions influence the development of the emergency events as well, for example, to make it more difficult to control, and to increase the rumors, etc.

**B. Short-term Effects**

At the beginning of the emergency events, it usually takes a period of time before the public can accept the emergency. And it is mostly during this time that various kinds of opinions emerge. In the short term, we concluded the social psychological effects of the Internet spread of emergency events into three stages as figure 2.

At the very beginning of Internet spread, opinions are usually given by some extraordinarily active persons, who are called opinion leaders. They command the information source more quickly than others and possess the ability to influence the public. So they play the critical role in the Internet spread, with their opinions agreed to by the mass netizens.
As the Internet spread progresses, the public start to separate into several opinion directions and form the group polarization at the end. The concept of group polarization was first presented by the American professor Cass R. Sunstein[20], referring to the phenomenon in the Internet community that members always have some inclination of their opinions and the extreme opinions may be formed finally as the initial inclination progresses in the discussing process. Likewise, in the Internet spread process of emergency events, the information and opinions that do more favor to the publishers are more likely to be published. The information selection is conducted at the same time that the emergency is spreading on the Internet. As a result, the phenomenon of group polarization gets strengthened. This exerts a heavy stress on the public. Netizens’ extreme emotion might be aroused by these polarized opinions. Further, Internet opinion violence may happen subsequently.

Since the virtual Internet world provides a feasible way for the people who are eager to release the dissatisfaction from the real world, malicious opinions are more likely to appear on the Internet. Those opinions exceed the normal range that the rational regulations allow to blame the concerned people and thus leave a heavy damage to the concerned people. However, on the other side, the negative phenomenon on the Internet promotes the improvement of the regulation of Internet spread, the social monitory, and other aspects, making it more possible to change the conflict into the non-violent form.

After all, compared with the spread in the traditional media, the Internet spread of the emergency events has the characteristics of being faster, wider, and more complicated, while also having the impacts of rumor diffusion and strong inflammation.

C. Long-term Effects

In the long term, the Internet spread of emergency events has influences on the individuals, society and the government, both in positive and negative ways. The impacts on these three subjects are complementary to each other. On the whole, the long-term social psychological impacts of Internet spread can be described as figure 3.

On the positive side, there are three effects on individuals, one on the whole society, and three on the governments.

For the individuals, firstly, the Internet spread increases the opportunities for the netizens to interact with the society, knowing and commenting the public affairs more conveniently. This adds the public’s social responsibility so that everyone undertakes his responsibility more actively. Besides, some information and opinions that are published via the Internet platform, concerning the governmental policy, may produce some influence on the government decision, such as strengthening the governmental monitoring on social affair, so that the public’s benefit will get improve. Thirdly, the frequent publication of some emergency events, for instance, the earthquake, SARS, etc, helps the public to have a more clear idea of those threatens. Most people will learn by themselves how the disasters happen, how to relieve themselves from panics, and how to survive in the emergency by watching and sharing their experiences through the Internet.

For the society, the Internet spread of the emergency events is helpful in relieving the social conflicts since more illegal behaviors are able to be exposed and corrected and the public are able to release their dissatisfaction via Internet instead.

For the government, the Internet spread has changed the traditional way of mass media so that more and more ordinary people get chances to participate in the national affairs, providing the information clues, conducting their democratic supervision rights, and changing the virtual
Internet platform into a real monitoring platform. Apart from this, the wide participation of the netizens in the governmental affairs widens and extends the public supervision, making the Internet a wider channel for the public to present their suggestion. Thus, the government will pay more attention to the social affairs and improve the procedure of news publication. Furthermore, major stream media will set more concentration on the Internet channel. Such powerful Internet supervision will make it possible for the government to discover and control more illegal phenomena and learn the people’s heart words.

On the negative side, there are two side effects on the individuals and social level, and another two on the governmental level.

For the individuals and social level, it is the wide Internet spread of emergency events that leads to the public credit crisis and damage to the private rights. The situation with public credit crisis is especially true in the corporation cases. For example, the exposure of the Sanlu Scandal in 2008 led to the great damage of its brand population. The damage to the private rights concerns the private life of ordinary people, adding various kinds of pressure to the concerned people that exceeds the normal level. And even some innocent persons are sometimes involved, having great and long-term harm to their life.

For the governmental level, the Internet spread does bring bigger challenge to the governmental management since the Internet spread makes it harder to get control of the Internet opinion and makes the negative opinions increase greatly. Danger of inflation may also occur through such a wide and convenient channel of the Internet. At meanwhile, the over exposure of the emergency events on the Internet may also bring the social crisis and credit crisis for the government, leading to the instability of the society.

To summarize, the Internet spread of the emergency events have both positive and negative impacts on the long-term effects. On the positive side, social individuals can get more information by this way to add their sense of social responsibility, and government is able to learn the experience to have better treatment to the future events and to improve the responding system successively. On the negative side, the Internet spread may lead to the public credit crisis which exert some incredible harm in the long term.

IV. THE EMERGENCY MANAGEMENT OF INTERNET SPREAD

A. Life-cycle Emergency Management of Internet Spread

Since the Internet spread has both the positive and negative impacts on the society, it is essential to build a effective emergency management mechanism. As is talked about above, the process of the Internet spread of emergency events can be concluded into a cycle model, which contains five phases. In this section we will present a life cycle emergency management strategy for the achievement of healthy spreading environment on Internet.

To treat the Internet spread as a special emergency, its management can be divided into the same five phases. In the first incubation stage, monitoring and warning of the Internet information about the emergency events is the major task for the management department. In the second outbreak stage, it should be put in the primary place to publish and to get the feedback of the emergency event information. In the stage of the opinion diffusion, to collect information and analyze the emergency caution constitutes the main responsibility of the management. The related department of government should be involved in controlling and guiding the opinion directions. In the following opinion decaying stage, emergency events that caused Internet spread of opinions should have been treated, and mass media starts to make conclusion and review of the whole process. In the last aftermath stage, the effects of emergency management are evaluated, and thereof the governmental regulations are usually revised and improved.

Summarily, the measures that should be taken in each stage are demonstrated in Table IV.

<table>
<thead>
<tr>
<th>Emergency Events</th>
<th>Internet Spreading Cycle</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beforehand</strong></td>
<td><strong>Incubation Stage</strong></td>
<td>Warning and Monitoring; Analyzing and Predicting</td>
</tr>
<tr>
<td><strong>Outbreak Stage</strong></td>
<td><strong>Publishing and getting feedback of Internet spreading information</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Diffusion Stage</strong></td>
<td><strong>Analyzing the caution of Internet spread; Making some opinion guidance via mass media</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Decaying Stage</strong></td>
<td><strong>Processing the emergency events; Reviewing the process of the Internet spread</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Aftermath</strong></td>
<td><strong>Aftermath Influence Stage</strong></td>
<td>Evaluating the emergency processing effects; Improving the management methodology and strategies</td>
</tr>
</tbody>
</table>

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Before the emergency event happens, the Internet spread is in the stage of opinion incubation. In this stage, three methods can be taken to make warming and monitoring of the Internet spread. The first method is the analysis of concentration extent, such as opinion analysis, website analysis and topic data seeking, etc. The second method is to use the web-based monitoring model to predict the public attitude. It uses web data mining technique to take out the related data and evaluate the public attitude. A model can be built to finally work out the concrete quantity of public attention, as well as the positive attention quantity and the negative attention quantity. The third method is to monitor the popular website to discover the clues with the techniques of RSS Feed, etc.

When the emergency event occurs, the Internet spread will usually experience three stages: outbreak, diffusion, and decay.

In the outbreak stage, the authorized Internet media should make the first-time reaction and publication to let the public know the real facts which may avoid the rumor information, since it is usually in the first 24 hours that the information is changed most severely and the public possess the biggest desire of knowing the the real situation. In the meantime, the feedback information about the psychological response, suggestions and demands of the public should be collected effectively from some hot websites and forums.

In the diffusion stage, there are two tasks to be conducted. First, the Internet news should be collected to analyze the caution of Internet spreading outbreak. Secondly, governmental guidance should be put into effect to avoid some side effects such as the Internet violence.

From the technical perspective, an Internet intelligence information system may be designed to detect the information publishing sources and collect the related information automatically. Furtherly, the related information can be analyzed intelligently. For example, the demanding information can be subscribed and there are functions to recognize and track the hot topics, analyze the opinion inclination and predict the developing trends.

To realize those functions, some major techniques are usually in demand:

1. The Internet intelligence information acquisition and extraction technique. The Internet intelligence used to be collected from the news, forums, blogs, etc, which are mostly embed in the dynamic webpages.
2. The Internet topic discovery and tracking technique. Since the topics that the netizens discussed about are countless, covering almost every aspects of the society, so the discovery and tracking technique should be applied to find out the hot and sensitive topics as well as their developing trends.
3. The Internet opinion inclination analysis technique. This technique is actually to abstract the author’s emotion direction according to the document contents. By this technique, the Internet spreaders’ emotion, attitude and intention will get reflected.

4. The multi-document abstract technique. Since most news and posts on the Internet contain lots of information garbage, the webpage contents need to be screened to keep the meaningful information for further processing.

In this stage, the concrete measures of governmental guidance may be considered as:

1. To create a diversified atmosphere to let the public have a place to express different ideas and release their dissatisfaction, while managing the major stream of opinions.
2. To cultivate the opinion leaders by adding expert column, consultation, scholar forums, etc to let the reliable and real voices occupy the market. This may strengthen the effect of opinion control.
3. To set some related special topics, which have great influence on the Internet opinion guidance, and help the mass media perform its social responsibility.

In the decaying stage, the emergency event has usually been processed, with the involvement of legal department and administrative department, etc. Besides, the Internet opinions are got controlled, reviewed by the mass media. Government publishes the processing result to remove the rumor.

Lastly, after the emergency event comes into the end, the Internet spread also goes into the aftermath influence stage. In this stage, the effects of processing and the results should to be evaluated to improve the management methodology and strategies of Internet spread. Evaluation basis may be established in a graded management system, which is built according to the length of the Internet spread outbreak period and the involved range. In such graded management system, several evaluation aspects can be taken into account, such as followings:

1. The harm extent of the Internet spread, including the harm to the individuals and government.
2. The control and its satisfaction degree of the Internet spread, and the improvement of the related systems and regulations.
3. The coordination of the governmental and social media resources in the management of Internet spread.

In the management of Internet spread of emergency events, the construction of netizens’ self-discipline plays an important role. The netizens’ civilization forms the basis of healthy spreading environment on Internet. Besides, the promotion of the real name system on the Internet in some countries has proved to be helpful in reducing the illegal and harmful events concerning the Internet spread. Additionally, the supervision of the government should be promoted to ensure the mutual justice of netizens and Internet managers.

B. Social Psychological Intervention Strategy

As we have analyzed in the third section, the Internet spread of emergency events may exert a series of psychological effects on the public, leading to the phenomenon of Internet violence, group polarization, etc. In order to lessen such harmful psychological impacts, it is necessary to make some intervention measures, such as:
1. At the moment when the emergency event occurs, the government should express its attitude and conduct emergency management effectively.

2. The authoritative information about emergency events should be in clarity to the public in the whole process of Internet spread.

3. The communication among the government, media and public should be strengthened, and the psychological tutoring should be set to reduce the public stress.

4. To guide the main stream of the Internet opinions and hold various kinds of grand discussion meeting that is open to the public to receive and share the suggestions from different views.

5. To avoid the extreme opinions and create a hospitable environment of Internet spread.

6. To encourage the active and hospitable way of expressing opinions on the Internet.

When the Internet violence occurs, correct psychological tutor such as the education of morality and regulation should be conducted at the first time, and law sanctions might also be taken when it is necessary.

For the victims of the Internet violence, the psychological service should be provided to help them recover from the harm and retain their confidence as soon as possible.

V. CONCLUSION

This paper researched the Internet spreading mechanism, presented an Internet spreading cycle model and worked out the influencing factors in that spread. After analyzing the long-term and short-term psychological impacts, a life-cycle emergency management methodology and the related strategies were proposed for the achievement of healthy spreading environment on Internet.

How to make use of the Internet opinion power to improve the governmental policy and to improve the psychological intervention strategy is our future research direction.

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Weihui Dai received his B.S. degree in Automation Engineering in 1987, his Master degree in Automobile Electronics in 1992, and his Ph.D. in Biomedical Engineering in 1996, all from Zhejiang University, China. He worked as a post-doctor at School of Management, Fudan University from 1997 to 1999, a visiting scholar at Sloan School of Management, M.I.T from 2000 to 2001, and a visiting professor at Chonnam National University, Korea from 2001 to 2002. He is currently an Associate Professor at the Department of Information Management and Information Systems, School of Management, Fudan University, China. Dr. Dai has published more than 120 papers in Software Engineering, Information Management and Information Systems, Complex Adaptive System and Socioeconomic

**Xiqiong Wan** received her B.S. degree in Mathematics in 2002, and her Master degree in project management in 2010, all from Fudan University, China. She works as a network engineer in Fudan University since 2002. Her major research fields are Information Security and Emergency Management.

**Xiaoyi Liu** received her B.S. degree in Optical Information Science and Technology from Fudan University in 2009. And she is currently a master student of Accountancy at University of Denver, USA.