

# Web Service Description for Mobile Phone Virus

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## Abstract

As the rate of utilization of the smart and mobile device grows up year by year, it makes the Smartphone begin to be paid attention in information safety. According to statistics, several hundred kinds of virus that can endanger the Smartphone have appeared which increase averagely at the speeds of six to ten of each month. The Mobile phone virus can spread through various methods, such as SMS/MMS, Bluetooth, Wireless LAN, etc. The study applied on TOVE ontology project method to construct virus behavior ontology of the cell-phone one by one. Last but not the least, experiencing Web Service borderless ability strengthens the strong ability to express of knowledge of ontology and achieves the purpose that knowledge share through Web Service. It is possible to let more people know behavior and potential danger of mobile phone virus very well. There is an important basis to give and study the experts and scholars in this field in the future too.

## Keywords

ontology; mobile phone virus; web service; smartphone

## 1. INTRODUCTION

Recently, according to the portable action devices, such as cell-phone, PDA, begin to be popular. The scale of the Smartphone grows up and the user who holds Smartphone increases day by day. The production was 57 million Branch in 2005 years and then grew up to 201 million Branch by 2008. However, its occupied rate of market rises from 6.81% in 2008 to 16.02% in 2005 (Digital Times, 2007). It serves to show how important the Smartphone on the cell-phone market is.

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With progress of information technology, there appeared the first virus piece-Cabir that travels under cell-phone in 2004. It mainly goes to search and possess other wireless devices with transmission function of Bluetooth through the blue bud line, and then sends an installation to infect the other side until it finishes the connection after searching and finishing. This procedure will cover and carry out until the battery of the cell-phone will be exhausted.

According to what the trend department of manufacturer of information safety announces of 2007 Threat Report and 2008 Forecast pointed out the threat of the information safety does not only appear on the PC. The threat that the action device faced has already nearly equated with the PC[29]. Among the action device of Wireless LAN also impel the production of the wireless hostile procedure. The action device makes out one of the main ways to spread with the hostile procedure [19].

According to the popularization of Mobile Internet, the circulation ways of the mobile phone virus are diverse such as WIFI, 3G, WiMAX. They are one of the media of mobile phone virus. The prevailing of mobile phone virus will cause a lot of outflowing questions, including individual privacy, business secret, telephone fee, and battery damage. Those problems are going to danger personal users and enterprise users. Thus, it is a very urgent topic to solve the issue of mobile phone virus; however, there are few relevant researches. It is expected to take the study to improve everyone's cognition and understanding of mobile phone virus.

The mobile phone virus has already become an important security topic which will produce huge impacts to enterprises and personal users. The virus can be infected through various kinds of channels and cause serious problems of damaging, blocking the service, telephone expenses, rubbish message, cell-phone of business secret, etc. From the above mentioned problems, it is obviously to know the dangers of mobile phone virus are wide and serious. So this research plans to build and construct ontology of mobile phone virus behavior that will describe the behavior and achieves the purpose that knowledge shares through Web Service.

## 2. MOBILE PHONE VIROUS

The definition of the virus is a program which can not only destroy and damage the user's system but will duplicate and spread out on other computers. In the research, hostile program is a file or program on magnetic disc. It will just like a time bomb to destroy or influence the user's system when a certain condition is touched. The Mobile phone Device nowadays adopts the similar function of PC to link the Web Service.[14] These action devices possess functions as operating system, text editor, excel editor and Access

editor etc. At the same time, it owns the ability of exchanging execution.[24]. Just because it is similar to the computer, it is easy to be invaded and spread the hostile procedure.[25] As wireless network cell-phone and PDA have grown up and complicated, the action devices are more and more difficult to keep virus out or to attack other hostile software, etc.[5]. The Mobile phone Malware can damage your action device through different ways, like exhausting the storing device space on the cell-phone or the behavior influencing the efficiency of the cell-phone. For instance, it will constantly send SMS, MMS and even turn basic function off. However, the worst situation might go for materials, delete valuable files and damage. When the trend, the action devices and a number of people go strong and increase, continues developing, we can predict the Malware will be the great threat on the information security in the future.

### 3. METHODOLOGY

According to the ontology possesses the powerful knowledge and expression ability, it can describe and narrate various kinds of behaviors of the mobile phone virus phenomenon. The research adopts its knowledge characteristic to effectively sketch the contours of the virus behavior features. Through the Ontology knowledge appears, it analyzes that mobile phone virus can't alter its behavior characteristics. Because Web Service is an open platform and open standard, such as UDDI, SOAP, WSDL, etc., it offers a service of cross-platform where the users can get the needed service depending on their demands. Therefore, this research is through the characteristics of Web Service to satisfy the purpose of knowledge sharing. It will help the future studying through the ontology carrying on relevant researches.

#### 3.1 Ontology

Ontology has existed in a field of Philosophy for a long time. Scholar Bunge[3] defined: that it is basic characteristic about the true world. But there are a lot of scholars utilize this characteristic to apply to computer science field, such as knowledge engineering, knowledge representation, qualitative modeling, language engineering, database design, information modeling, information integration, object-orient analysis, information retrieval and extraction and knowledge management and organization, etc.[27]. In the research community of artificial intelligence, a good mechanism, neural network, and fuzzy logic is supported by a good domain content theory and its language. Ontology is a content theory because it contributes in finding out a relation between objects. Guarino[12] puts three characteristics of Ontology. First, it can describe all things in this world; second, it reaches Syntactic Interoperability and third, it reaches Semantic Interoperability. By the above characteristic, Ontology can not only present the essence of field knowledge, and can describe the concept, attribute of the knowledge content, and the relation between the concepts. Thus, it can present the knowledge structure through the theoretical foundation of Ontology and clearly describes the knowledge content.

There are two methods often used in the Ontology that one is a project method from M. Uschold, another Toronto Virtual Enterprise is from M. Gruninger. According to the research of Fernandez Lopez, the highly and completed Ontology are developed by Micheal Gruninger[4][8][10][12]. Thus, this research plans to adopt Toronto Virtual Enterprise. Otherwise, there are 6 stages in TOVE project. The first stage: Motivation Scenario is the motivation of definition in Ontology. The second stage, Informal Competency Question, sums up the question that ontology must be answered from the first stage to see if these questions will be used to assess ontology in the future. The third stage, Terminology, is

about the domain term that will be used in ontology. The fourth is Formal Competency Question to find out the connection between the second and the third stage. Axiom, the fifth stage, is used to express the rules and restricts form the language in the third stage. Last, Completeness Theorem will use Competency Question to evaluate whether the built Ontology can satisfy the motivation of the first stage. Figure 1: The connection of 6 stages in TOVE project[12].

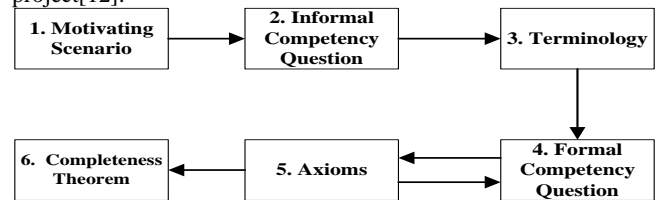


Figure 1. TOVE : Six stages of ontology engineering.

This research adopts Protégé 4.0 which was developed by W3C (World Wide Web Consortium, W3C) OWL language and Stanford University SMI (Stanford medical informatics) as the instrument of knowledge construction.

#### 3.1.1 Protégé

Protégé is a knowledge base platform developed by Stanford Medical Informatics. Its greatest characteristic is to apply the idea of Ontology and design a Frame-based expression and an environment of developing the inference engine. In addition, it includes module of OKBC (Open Knowledge Base Connectivity) to enable workers to construct a cross-platform knowledge management system based on Ontology. Protégé is not only one of the most important platforms in the world but also an extensively used platform to support Ontology. This research uses Protégé 4.0 to develop behaviors of mobile phone virus.

#### 3.1.2 OWL(Web Ontology Language)

This research built Ontology through World Wide Web Consortium, W3C where it organized Ontology Web Language, OWL. OWL is that W3C Web Ontology Working Group issued in 2004. It shows interaction between all existed files in the network and the application program because the file and application program will demonstrate variously when tools are different. So, it will be a new standard of Semantic Web while OWL makes the content change into not only people understand, the machine and application program are also all clear.

#### 3.2 Web service

Web Service is by World Wide Web Consortium (W3C) Design and designated which is used for promoting and stepping the communication among the platforms. Yap[25] refers to the development of Web Service that it can divide into several stages on the concept, design, manufacture, test, and merge of the software component to develop and innovate and then system combination is finished finally. The supreme goal of UDDI specification in Web Service is to integrate different software components from various manufacturers. According to End Users' needs give the relevant service. The mobile phone virus has already become an important security topic which will produce huge impacts to enterprises and personal users. In order to realize the structure of the software service, standard and protocol that Web Services is correlated are made and popularized successively in recent years, numerous manufacturers have offered the tools and fast development environments. These standards and protocols, the

majority is all with XML (eXtensible Markup Language) as a development foundation. The main standards and protocol include:

### 3.2.1 SOAP (Simple Object Access Protocol):

A definition of point-to-point in depositing and withdrawing protocol. (Martin et al., 2003). The simple function of depositing and withdrawing protocol is to offer a common standard for service application to communicate with each other.

### 3.2.2 WSDL (Web Services Description Language):

The network service describes languages which mainly describe Web Services and let Service Request know how to use this Service. It includes the operations of Web Service and describes the transmission protocol, the form of the materials, and parameter form of the content. It is a kind of file written by XML, extension is WSDL transmits through the website. Therefore, when Service Request gets obtains WSDL website of this service that Service Provider offers through UDDI, it will know how to call out Service through the file and get serve and exchange the materials.

### 3.2.3 UDDI :

The registration of the internet network service and search the mechanism. This function is mainly to release one's Web Service on the network and let those who need help can seek service. But the service of UDDI must build and construct the lower standard protocol such as SOAP, XML, HTTP. Web Service is not only the association of relevant technology, but a kind of concepts and ideas too.

### 3.2.4 XML(Extensible Markup Language) :

A standard of information exchanging of Web Service. Different platforms can exchange materials if they have output and the ability of analyzing XML. XML is an extension of mark language. It mainly defines as a description of cross-platform and standards of exchanging formats and a content of the pure characters. As long as both sides confirm the meaning of labels, it can be explained by written XML parser. Because it is only the pure characters, it can cross the platform and step the software. Web Services utilizes XML as the medium of materials exchanging and uses for defining the files between the communication of Service Request and Service Provider and XML can support the webservice.

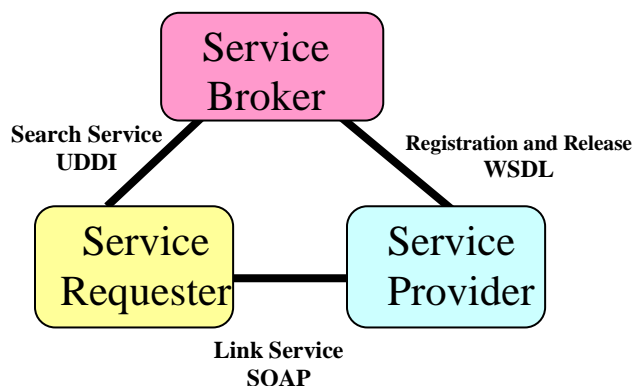


Figure 2. Web service.

## 4. DATA COLLECT AND ANALYSIS

### 4.1 Data Sample Collection

Since virus Cabir has been found in June, 2004, Malware has exceeded 400 and were increasing until July, 2008. This research collect 33 samples of Malware which are from network downloads and seeking and software manufacturer. Through the model classification of Malware, Table 1 is as follows. The research adopts five famous software, Trend Micro, Symantec, Kaspersky, F-secure, McAfee to prove each collected malware is precisely executed under the environment.

Tabl 1. The sample classification of Malware

Type	Target OS	Name
Trojan	Symbian	Appdisabler.J , Blankfont.A , Bootton.A , Cardblock.A , Cardtrap.A , Cdripper.A , CommDropper.A , Doomboot.A , Flerprox.A , Fontal.A , Gavno.A , Locknut.A , MGDropper.A , Mosquitos , Pbstealer.A , RommWar.A , Romride.A , Skudoo.A , Sendtool.A , SDropper.A , StealWar.A , Skulls.A , Singlejump.A
	Java	RedBrowser
Trojan-spy	Symbian	FlexiSpy.A
Worm	Symbian	Cabir.A , Commwarrior.A , Lasco.A
	Symbian, VBS	Eliles.A
Virus	Windows	Duts
	Windows	Cxover.A
Spyware	Symbian	Acallno.A , Mopofeli.A

a. Sample of a Table footnote. (Table footnote)

### 4.2 Handset evil intention software behavioral analysis

Generally using Smartphone causes cell phone to become the main attack target of Malware. The cell-phone user has no security consciousness which lets cell-phone expose in the Malware threatens. In addition, the action device has more transmission media than the PC, and the speed of spreading is fast even more too. The injury caused is greater. Therefore, security and risk of taking action are important issues. As mentioned above, MMS and Bluetooth can be the most possible infections because they can

extremely easy offer the address and contact methods. The Malware software can be spread and automatically send contacts through MMS. Infected cell phone usually possesses MMS function and suitable platform, but it is usually too late to find unusual operations or have traffic volume MMS sending.

### 4.3 cell phone malicious software type

The mobile phone malware can damage your action device through different ways, like exhausting the storing device space on the cell-phone or the behavior influencing the efficiency of the cell-phone. For instance, it will constantly send SMS, MMS and even turn basic function off. However, the worst situation might go for materials, delete valuable files and damage cell-phone. It will cause users to take much time and mental and physical efforts to solve the problem. This research summarizes the mobile phone device may cause various damages.

## 5 RESULTS OF THE EXPERIMENT

### 5.1 Ontology Construction

This research uses Protege 4.0 of centre of SMI as the instrument of Ontology in the research., and cooperate with Scholar[12] whose TOVE ontology project as constructing procedures to build mobile phone virus behavior Ontology. The constructions and procedures of TOVE Ontology project are as follows:

#### 5.1.1 Motivation Scenario

Recently, the progress of Smart phone function is more and more popular. But in the past 3 years, the amount of smart phone virus constantly increase and have already been close to 300 even. The mobile phone virus may cause the questions as the information revealed, overcharged and exhausting the electricity of the battery. Because the essence of domain knowledge that Ontology appears can describe knowledge functions and concepts. This case study mainly discusses different behavior characteristics and constructs Ontology of mobile phone virus. Here are some findings about unchangeable characteristics in Mobile phone virus.

#### 5.1.2 Informal Competency Question

In the step 2 states motive forming process: application and function of Ontology. In the future application, Ontology needs answer questions according to designed principles. The statements are as follows:

- CQ1: How to define the type of the Mobile phone virus?
- CQ2: How to explain the behavior characteristic of the Mobile phone virus?
- CQ3: How to define the infection of the Mobile phone virus?
- CQ4: How to define the attack types of the Mobile phone virus?
- CQ5: How to define the scattering situation of the Mobile phone virus?
- CQ6: How to define the damaged types of the Mobile phone virus?

#### 5.1.3 Terminology

The stage defines all the specialized terms in the Ontology. In Ontology of the virus behavior this research divides the behavior characteristic of the Mobile phone virus into 5 aspects, namely the infection technology, infecting behaviors, cheating, damages and many types of Mobile phone virus.

#### 5.1.4 Formal Competency Question & Axiom

The application of Step 4 - 5 used in Terminology transform non-formalized ability issue to formalized ability issue. But these terms are unable to be used for stating deeper relation; it needs to use relevant principles to construct the norm. By analyzing behavior characteristics constructs the Ontology of Mobile phone virus. This research has proved the ability problem, problem solution and designed principle of non- formalized. The Ontology can be used in the measuring of the Mobile phone virus.

#### 5.1.5 Completeness Theorem

The integrality question is used in the last step, to verify the rationality of Ontology. Protégé 4. 0 can construct the content of Ontology and be technically judged. To adopt the steps mention above, here is the analyzing from Protégé 4. 0 to construct the Ontology behaviors of Mobile phone virus in Figure. 3.

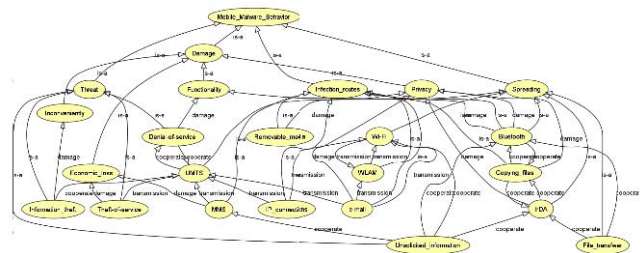


Figure 3. Cell phone virus acts ontology.

### 5.2 knowledge sharing by Web Service

This research uses the strong knowledge of ontology to present ability. Experiencing Web Service and borderless Internet achieves the purpose that knowledge share. Figure. 4 is Web Service structure of this research. In philosophy, the term "ontology" is considered in the real world has a physical (entity) the classification and will have a decisive description.[35] In the field of computer science, the term "ontological" concept is the formal for the group to share and made it clear that the conceptualization of the form, through the establishment of a functioning mechanism to allow people to handle a large number of information, we can help people to rule-oriented the steps needed to identify the important knowledge[11]; Therefore, ontology of the modern era of information explosion, how the information in the Extract from a large number of knowledge needed is very important technology. For knowledge sharing and application of level of knowledge, scholars, Scholars[35] pointed out : the use of ontology and standard definition can be achieved through knowledge sharing and reuse purposes, and can be defined the field of ontology (domain ontology) applied to other fields : Ontological basis of this study show a strong knowledge and ability, knowledge sharing and application of knowledge level, through a Web Service architecture and the Internet, far-reaching properties, in order to achieve the purpose of knowledge sharing, Figure 4 for this study Web Service architecture.

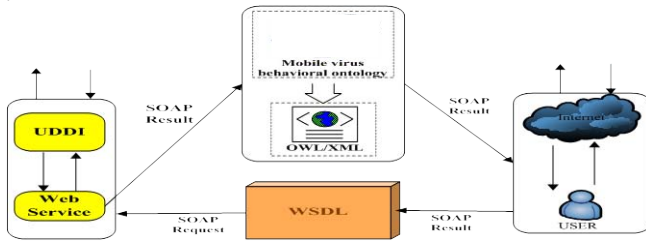


Figure 4. Cell phone virus ontology of Web Service Architecture.

In Figure. 4, the components of Web Service transmit and search the knowledge content. UDDI can satisfy user's demands and release to Web Service. Through SOAP protocol, it offers a standard to reach the mutual communication. These exchange standards of main materials as regarding XML as main transmission and exchange standard. The form below is a grammar of XML changed from the Mobile phone virus behavior in order to express the content of the knowledge.

Table 2. As to the contents of XML to express ontology

```
<?xml version="1.0" ?>
<!DOCTYPE Ontology [
  <ENTITY Y owl "http://www.w3.org/2002/07/owl#" ?>
  <ENTITY Y owl "http://www.w3.org/2001/XMLSchema#" ?>
  <ENTITY Y rdf "http://www.w3.org/2000/01/rdf-schema#" ?>
  <ENTITY Y rdfs "http://www.w3.org/1999/02/22-rdf-syntax-ns#" ?>
  <ENTITY Y Chublog "http://www.semanticweb.org/chublog/2009/08/Chublog-12151819210500.owl#" ?>
] ?>
<Ontology rdf:base="http://www.w3.org/2000/01/rdf-schema#"
  rdf:base="http://www.w3.org/2000/01/rdf-schema#"
  rdfs:label="http://www.w3.org/2000/01/rdf-schema#"
  >
  <SubClassOf ?>
    <Class URI="http://www.w3.org/2000/01/rdf-schema#DomainOfService" ?>
    <Class URI="http://www.w3.org/2000/01/rdf-schema#Thing" ?>
  </SubClassOf ?>
  <SubClassOf ?>
    <Class URI="http://www.w3.org/2000/01/rdf-schema#DomainOfService" ?>
    <ObjectProperty label="From" ?>
      <ClassProperty URI="http://www.w3.org/2000/01/rdf-schema#cooperate" ?>
      <Class URI="http://www.w3.org/2000/01/rdf-schema#UMI ?" ?>
    </ClassProperty ?>
  </SubClassOf ?>
  <SubClassOf ?>
    <Class URI="http://www.w3.org/2000/01/rdf-schema#DomainOfService" ?>
    <ObjectProperty label="From" ?>
      <ClassProperty URI="http://www.w3.org/2000/01/rdf-schema#dama ?" ?>
      <Class URI="http://www.w3.org/2000/01/rdf-schema#From to reality" ?>
    </ClassProperty ?>
  </SubClassOf ?>
  <Declaration ?>
    <ClassProperty URI="http://www.w3.org/2000/01/rdf-schema#dama ?" ?>
  </Declaration ?>
  <TransitiveClassProperty ?>
    <ClassProperty URI="http://www.w3.org/2000/01/rdf-schema#transmission" ?>
  </TransitiveClassProperty ?>
  <Declaration ?>
    <ClassProperty URI="http://www.w3.org/2000/01/rdf-schema#transmission" ?>
  </Declaration ?>
</Ontology ?>
<!-- Generated by the OWLAPI (version 2.2.1.974) http://www.semanticweb.org/net -->
```

a. Sample of a Table footnote. (Table footnote)

## 6 CONCLUSIONS

According to the growth of Smartphone's utilization rate, people's reliance is quite improving. The Smartphone can be more popularized on action commercial; however, its popularization at the same time can cause some questions. The Mobile phone virus mentioned in the research has no quite threats at present, but its potential danger is not allowed to be looked small. There is a suitable potential risk in the Smartphone to be pointed out according to McAfee Avert Labs. It even increases averagely at the speeds of six of each month. The security of Mobile Device will be an important and urgent problem.

This research collected through the Mobile phone virus sample to analyze the unchangeable characteristics behaviors to complete analyzing of virus behaviors. From the research, it is clear to see the threats of Mobile phone virus are quite serious which may cause the harms of communication losing, revealing personal secrets, and cell-phone function injuring. But there are few relevant studies at present; this study research proposes Mobile virus behavior Ontology for the Mobile phone virus,

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