

# Privacy Security Issues under Mobile Cloud Computing Mode

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**Abstract** - The paper introduced the basic concept and background of Mobile Cloud Computing, analysed the inevitability and necessity to provide mobile internet services based on cloud computing technology, proposed the service framework for mobile cloud computing, analysed potential security issues and relevant technologies to protect privacy information of users under mobile cloud computing environment.

**Index Terms** - mobile cloud computing, privacy security, framework, mobile internet, cloud security

## 1. Introduction

Cloud computing technology has been widely considered to be an important growth point of the IT industry after the prosperity of Internet. It is based on the thinking that "the network is the computer" and connected large number of computing resources, storage resources and software resources together to form a huge scale shared virtual resource pool. Cloud computing has broken the traditional one-to-one service model and was able to provide unlimited, scalable, and easy access to IT resources and services for remote computer users, which achieved the real allocation of resources according to needs. According to the estimates of Gartner Company, the revenue of global cloud computing is expected to reach \$ 148.8 billion in 2014.

With the rapid development of mobile communication technology and the growing popularity of intelligent terminals, there is an urgent need to get information and services from the Internet at anytime and anywhere even during the movement. The urgent needs of information and services promoted the incorporation of Internet technology and mobile communication technology, and finally formed the Mobile Internet. According to "2013-2017 China Mobile Internet Industry Market Outlook and Investment strategic planning analysis report" [1], up to the end of June 2012, the number of Internet user in China has reached 538 million, of which the cellphone netizen has reached 388 million. The proportion of Internet user accessed by mobile phones increased from the previous year's 69.3% to 72.2%, and this change is still growing. China has entered a rapid development of the Mobile Internet era.

The continued development and integration of Cloud Computing and Mobile Internet result in a new application model—Mobile Cloud Computing (MCC). Mobile Cloud Computing transferred the storage, computing and other resources from local area to the "cloud". Users can achieve varied forms of services such as file storage, mobile

navigation, voice searching, cellphone maps by intelligent mobile device with client terminal. Mobile Cloud Computing brought unprecedented entertainment experience to users, but at the meanwhile its security problem has become even more prominent, which becomes one of the technical difficulties that must be solved.

## 2. Mobile Cloud Computing

### A. Concept and Characteristic

According to the definition of cloud computing, mobile cloud computing refers to the delivery and using patterns of infrastructure, platform, software (or application) of IT resource (or information) by mobile network according to the real demand and in a scalable way, it is the application of cloud computing technology in the mobile Internet [2]. The connotation of mobile cloud computing is to store and process data beyond the terminal device, which not only solved the insufficient computing resources of mobile terminals effectively, but also improved data acquisition capabilities greatly, benefited management of distributed hardware.

The advantages of mobile cloud computing technology can be summarized into the following aspects. Firstly, it breaks through the hardware limitation of terminals and facilities data acquisition. Compared to desktop computers, the significant problem of mobile terminals is lack of resources, mainly reflected in less screen area, limited computing capability, shortage of storage resource and restriction of battery capacity etc. Generally, mobile cloud computing is considered to be a Software-as-a-Service (SaaS) cloud, it transferred the calculation and processing functions of application from the terminal to the cloud. Mobile terminals are able to use the computing resources, storage space and variety of software applications supplied by cloud service providers without doing much work but to send commands and receive data through the browser to the "cloud". Secondly, mobile cloud computing reduces the requirements of network and simplifies the way to realize business. For example, when users need to view a file, it is not necessary to send them the entire file but only give them the part they needs. This helps to provide different users with different service experiences in accordance with actual needs under the limited bandwidth circumstances. Since the application is implemented and deployed on the powerful server side, terminals are not aware of the specific implementation method, thus it is much easier to extend the application and realize interaction with users in a uniform

manner (for example, through a browser) on terminals. Finally, thanks to the huge resource pool of cloud computing, users of mobile cloud computing can buy services on their demand, just like purchasing water, electricity and gas. The versatility of "Cloud" reduces the cost of managing and using, and increases the utilization of resource significantly.

#### B. *Inevitability and Necessity*

The development of information technology impelled the changing needs of users, traditional services such as SMS, MMS, downloads etc. can not meet the needs of mobile phone users. Mobile Internet provides good communication architecture for users from the terminal to the data center, with the popularity of smart phones and increasing variety of applications, terminals need to do more and more computing work, which is a major constraint for a mobile terminal with limited resources. Use cloud computing technology to carry out remote computing and data storage, this problem will be solved. Cloud computing brings the huge computing and storage capacity of companies into play, correspondingly, performance bottlenecks of terminal will gradually disappear. Another benefit of cloud computing is more convenient and efficient data sharing, for business users, the use of cloud storage can greatly coordinate the progress of work, and achieve collaboration of mobile computing and desktop computing.

On the other hand, cloud computing technology aggregates the telecommunication and Internet capabilities into the "cloud" and is open to developers, this will help to change the situation that mobile services provider has low level of participation in mobile internet business, and enhance the position of mobile services provider in the chain of industry by operating the platform. Therefore, to provide mobile internet services based on cloud computing technology is an important method and inevitable choice for telecom services providers to increase competitiveness and avoid becoming mere "pipe".

#### C. *Framework of Mobile Cloud Computing*

The large scale of computation and shared mode of storage resources of cloud computing has brought significant influence to the whole architecture of the mobile Internet. The application framework of mobile internet including cloud computing can be divided into three levels, involves "terminal", "network" and "cloud", shown in Fig.1. "Terminal" refers to the mobile terminal equipment of users, it is the platform to display various businesses and interact with users, which can be smart phones, laptops or PDA. "Network" involves the total part of the mobile internet, including the access network and the Internet. Since the terminals have different types, there are different kinds of access methods for mobile internet, such as GPRS, 3G, Wi-Fi, etc. "Cloud" refers to the comprehensive system composed by infrastructure, platform and application software, which provide IaaS (Infrastructure-as-a- Service), PaaS (Platform-as-a- Service) and SaaS (Software-as-a- Service) services. The infrastructure consists of parallel distributed computing systems, servers,

storage devices, databases and other components. Platform includes operating platform, supporting platform, development platform etc., while application software includes various kinds of software, data and information.

### 3. Threats of Private Security under Mobile Cloud Computing

The combination of cloud computing and mobile internet will not only face the double security threats from traditional internet and mobile communication network, but also introduced the security risks of cloud computing technology, which brings unprecedented data security challenges to user's data under mobile cloud computing environment. On one hand, the right of ownership and management of user data will be separated in the model of mobile cloud computing, user has to transmit, access, store and use their data through the mobile internet and cloud platforms. How to prevent user's data from lost, stolen, tampered during network transmission? How to ensure cloud computing service provider has did correct storage, manage, access and destruction? That is the major problems for the security of user data. On the other hand, the property, location, movement trajectory, using habits and other private information of users have also become highly sensitive data under the mobile cloud computing model. How to prevent illegal positioning, tracking, privacy mining have become an important issue related to the safety of users.

According to the framework of mobile cloud computing, security of user data under mobile cloud computing environment should run through the different levels of network system, including the security of mobile terminals, security of mobile internet and security of cloud computing platform.

#### A. *Security Issue of Terminal*

Mobile terminal is the most important part to distinguish the mobile internet with the fixed internet, and it has become a part of people's modern life. The high sticky degree of mobile terminal to people and its always-on feature is likely to attract eavesdropping and surveillance problems, leading to higher sensitivity of user data and more dangerous when information has been revealed. Operation systems of intelligent terminals nowadays are not perfect, and there are many security vulnerabilities yet to be resolved. As the client-side of applications under mobile cloud computing environment, browsers still have some software vulnerabilities. What's more, users of mobile internet are lack of safety awareness while using cloud services compared to PC users. It is easy to be infected with the virus or intrusion while receiving SMS, MMS or browsing mobile web, downloading and installing software, result in data leakage (lost address book, local files, phone-call and internet records, location information, schedules, various network accounts and banking passwords, etc.), equipment damage (terminal crash, slow down, function failure, system formatting, frequent automatic restart, etc.) and economic losses (pirate the call, malicious ordering the SP business, send MMS, etc.).

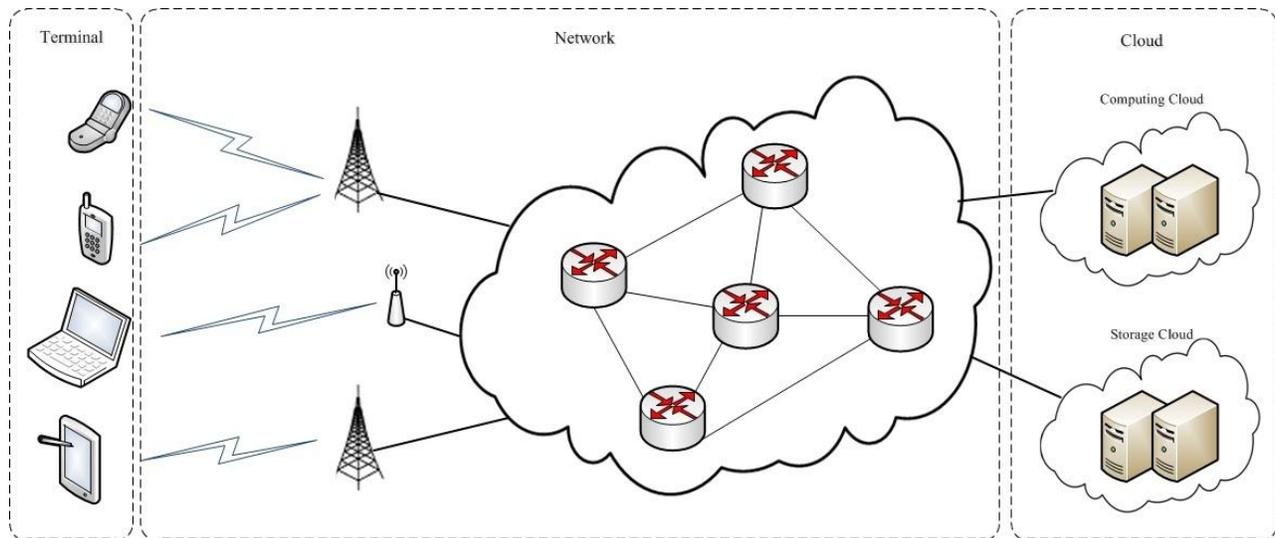


Fig. 1 Framework of mobile cloud computing

### B. Security Issue of Network

Compare with the traditional internet, users of mobile cloud computing need to get resources and services via the wireless communication network. Because mobile internet has increased the wireless access method, and introduced a large number of WAP gateway, IMS equipment into the IP network, many new security threats emerged in the mobile internet [3]. The nature of wireless transmission decided mobile cloud computing has some security risks in connection authentication and data protection aspects. Among them, access to the network illegally by breaking the wireless interface and monitoring, stealing, attacking the message transmitted on the air interface is particularly prominent. Secondly, as a part of the internet, mobile internet is also faces the threats of virus and security challenges from the internet. Differently to the traditional internet, mobile internet has introduced NAT (network address translation) technology because of the limited IP address resources of IPv4. Although it has solved the shortage of address resources effectively, it has also destroyed the transparent "end to end" architecture of internet. Finally, the real-name system of mobile phones has not yet popularized in China, which provides the opportunity for criminals. Illegal terminals may enter into the wireless communication network by a fake identity and carry through variety of destructive activities, making the mobile internet to become one of the main roads to carry out cyber crime.

### C. Security Issue of Cloud

The new security risks introduced by cloud computing to the mobile internet are mainly reflected in the end of cloud services [4]. Firstly, virtualization technology brings scalable features to cloud computing, but virtual machines of different users might be running on the same physical storage device, if the software of virtual machine has some security vulnerabilities, the user's data may be accessed by other users running on the same physical storage devices. If the physical host has some problems, then all the virtual machines running

on it will have problems. Secondly, the data of different user's is stored and managed centrally under the cloud computing environment. How to ensure the security management and access control mechanisms of cloud service providers are accord with the security needs of customers? How to implement an effective security audit and monitor the safety of data operation? How to avoid the potential risks of coexistence multi-users under cloud computing environment? These are all serious problems waiting to be solved. Thirdly, user's data and service application are located in the cloud computing system, their business processes will depend on the services provided by cloud computing providers, which proposed new challenges to the service continuity of cloud platform, SLA and IT processes, security policies, event handling and analysis. When the cloud system goes wrong, how to recover user data rapidly has become an important issue. Finally, cloud platform is easily to become the target of hackers due to the highly concentrated users and information resources. Destructive consequences caused by denial of service (DoS) attacks will significantly worse than that on traditional network.

## 4. Protection Strategy of Private Security

Security of privacy data is the most important issue that user concerned about under mobile cloud computing environment, it will directly affect the development of variety of business. The security of user data should be considerate from many aspects such as transmission, storage, isolation, encryption, data access and etc. According to the three levels framework of mobile cloud computing, and take the security safeguards for internet and cloud computing for example, protection of privacy data under mobile cloud computing should be carried through from the following aspects.

### A. Terminal Security

To protect user information on the mobile terminals, prevention is more important than technical method. Password

can be set on the terminals to authenticate the user's identity and to prevent the leakage of user data on the terminals when it is lost or stolen. In addition, the lost data on mobile terminals can be erased by some devices or remote server in order to prevent private information falling into evildoer. Improvement of using habits, enhance the awareness of virus prevention, install anti-virus software are all the effective manners to prevent malicious software attacks. Select legitimate location server and appropriate location privacy protection method will maximize the protection of private information such as location, trajectory and using habits while using the location-based services.

### B. Network Security

On the side of network, the work is to enhance the access and transmission security of mobile internet. Take the technical advantages of the authentication and traceability of mobile internet and bind the user address and identity, so that authentication can be traced to fully play its deterrent effect and strengthen the control of user's behaviours, the overall strength of the network security will be improved [5]. In addition, besides the transmission of data needed by services, there has more data transmission caused by dynamic adjustment of data under the mobile cloud computing environment. The biggest threat for this kind of data transmission is to be transmitted directly in clear text without any measure of encryption. Therefore, adopt secure transport protocols and "end-to-end" encryption method can effectively ensure the confidentiality and integrity of information during transmission.

### C. Cloud Security

Security mechanisms on the side of cloud platform should be considered from the storage of data, isolation, encryption, access control and etc. Take Amazon for example, data storage process in S3 system will generate an MD5 hash automatically, eliminated the burdensome work of using additional tools to generate verify result and ensured data integrity effectively. IBM designed the "ideal lattice" mathematical objects, using homomorphic cryptography mechanism to accomplish data operation in the state of encryption without disclose the private information, which is a good solution to the privacy problem of user data in cloud computing. In cloud computing environment, the physical security boundary of system will gradually disappear, replaced by the logical security boundary. Cloud computing systems widely use "Multi-Tenancy" architecture, and data of all users are shared in the "cloud". In order to ensure the effective isolation of data, Shared Schema Multi-Tenancy, Separated Database or Shared Database Separated Schema can be used

to solve the problem of data isolation. Finally, strengthen the access control of user data and system business within mobile cloud computing [6], through unified authentication technology, resource certification, collaborative certification, and authentication between different security domains or multiple authentication methods [7], may prevent unauthorized access to user data and illegal modification or interruption of business processes.

## 5. Conclusion

Mobile cloud computing is the inevitable product of the integration of mobile communications, internet and cloud computing technology. The evolution trends of intelligent terminals should not just be a micro-PC. Application of cloud computing combined with 3G bandwidth and reasonable rates, microphone of intelligent terminals will become the ear of user, the camera will become the eye, GPS chip will become the guide.... Take full advantage of these features, the mobile internet will bring user excellent experience far beyond the traditional internet. For the future development of mobile cloud computing, "cloud" will be the core of the service, terminal is the carrier and presentation platform, privacy security is the main restrict problem affecting the popularization of all kinds of business.

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## References

- [1] Huatai business research institution, "2013-2017 China Mobile Internet Industry Market Outlook and Investment Analysis Report and Strategic Planning", 2013.
- [2] Ruyue Deng, Chuan Qin, Xianzhong Xie, "Application status and problem analysis of mobile cloud computing", *Journal of Chongqing University of Posts and Telecommunications (Natural Science Edition)*, Vol.24, no. 6, pp. 716-723, Dec. 2012.
- [3] Bingyi Fang, Yunyong Zhang, Jun Wu, "Analysis on mobile internet application security issues based on the cloud computing mode", *Telecommunications Science*, 29(3), PP.41-47, 2013.
- [4] Zisis Dimitrios, Lekkas Dimitrios, "Addressing cloud computing security issues", *Future Generation Computer Systems*, 28(3), pp.583-592, 2012.
- [5] Fang Ming, Yaxiong Peng, "Security and strategy of mobile internet", *Communications Technology*, Vol.46, No.04, pp.19-21, 2013.
- [6] Tiande Tong, Xudong Liu, Taofeng Guo, et al, "Analysis and practice of cloud computing information security", *Telecommunications Science*, 29(2), pp.135-141, 2013.
- [7] Elisa Bertino, Federica Paci, Rodolfo Ferrini, "Privacy-preserving Digital Identity Management for Cloud computing", <http://www.uceresource.org/articles/Engineering/2009/BODE-09-vol-32-1-3.pdf>.