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The Test Scheme of LBS in the TD-SCDMA System

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Abstract: As an important value-added mobile service, many LBS related technologies have been proposed recently. Function and performance test is a crucial step for commercializing a new technology. Here we focus on the test scheme of LBS in the TD-SCDMA system. The LBS test environment and test flow is designed. It is useful for validating the LBS processing and optimizing network performance.

Key words: TD-SCDMA standard; location-based service; test scheme
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1 Introduction

During recent 20 years, the mobile communication technologies are developing rapidly. The mobile communication system is developed from the first generation analog communications to the third generation digital CDMA communication system. The ITU has issued three main third generation mobile communication (3G) standards, which includes the TD-SCDMA system submitted by China[1,2]. With the popularization of mobile terminal such as handset, PDA, etc., mobile subscribers require not only high quality voice communication, but also other data services such as the location based service (LBS). There are many LBS technologies have been proposed by now, for example, high precision location determination technologies (LDT), efficient LBS application development platform, etc.. LBS is provided by mobile system as one of the value-added services, meanwhile, it can also be used to enhance or support certain O&M (Operation & Maintenance) related tasks. In the Release 5 version of the TD-SCDMA standard, related technologies and specific service types of LBS are proposed. Nowadays, both the providers and equipment manufacturers of TD-SCDMA system are developing commercialized products based on the Release 5 for supporting the LBS services. It is no doubt that before commercializing LBS services, systematic test for function and performance will be brought into effect.

2 LDTs supported in TD-SCDMA system

Basically, the TD-SCDMA system provides four kinds of location determination technologies, Cell-ID, OTDOA, AGPS, and AOA [1,2]. The cell-ID based (i. e. cell coverage) positioning method, which estimates location of the target UE (User Equipment) with the knowledge of the serving Node B. The location precision is not very high. OTDOA estimates and calculates the target UE location with the observed time difference of arrival of radio signal measured by the UE and LMU (Location Measurement Unit). The theoretic location precision of OTDOA is about 1/8 chip (i. e. 30 meters). This positioning method requires at least 3 Node Bs or LMUs being involved for measuring and estimating the time difference between UE and Node B or LMU respectively. For AGPS method[3], the UTRAN (UMTS Radio Access Network) transfers GPS assisted information to UE which embedded GPS

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receiver chip via Uu interface. The UE receives and measures the GPS signal using the GPS assisted information. If it is in UE assisted mode, the UE transfers the measured information to UTRAN, and the final location is calculated in the UTRAN. If it is in UE based mode, the UE calculates the location locally and then transfer the result to UTRAN [2,3]. AOA calculates the location of target UE via a single Node B, it measures the UE angle and the time difference between UE and serving Node B with the support of smart antenna.

In the real implementation, hybrid LDT solutions, such as AGPS/OTDOA and Cell-ID/AGPS, adapt to different application environment[4].

3 The LBS architecture in TD-SCDMA system

In the TD-SCDMA system, the UE, the URTAN and the CN (Core Network) will participate in the LBS processing [2]. Fig. 1 shows the LBS architecture in TD-SCDMA system, which does not include the entities which are not involved in location services.

The LMU entity takes charge of measuring for one or more positioning methods, and it can be stand alone or associated with Node B . The GMLC (Gateway Mobile Location Center) is the first access node for an external location application in TD-SCDMA system, which performs registration authorization and requests routing information from the HSS (Home Subscribers Server) [2]. External LCS Client is an external location server that can send location requests for the given UE to GMLC or get response from GMLC via Le interface .

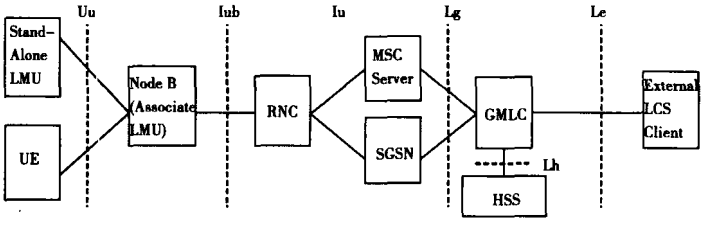

Fig. 1 The LBS architecture in TD-SCDMA system

There are two types of LBS processing according to the source of LCS request from in TD-SCDMA system [3]. The below procedures do not include the communication details which are not involved in location service directly.

(1) The external clients request target UE location procedure. The external clients are the users beyond the PLMN. The external client sends LBS request to GMLC entity via Le interface. The request includes location information and parameters, such as request type (i. e. immediate or deferred), the position QoS, the target UE identification and so on. For immediate request, the GMLC checks the privacy information from HSS. If the check is successful, it will return the LCS response to client directly. For deferred request, the SMLC (serving MLC routed by HSS) will send "provide subscriber location" to MSC after successful check. The MSC exchanges the LCS location information with UE via supplementary service, and sends location request to UTAN. The UTAN lets Node B and target UE make measurement procedures according to the different position method and technology. If it is in UE based mode, the target UE evaluates and calculates its position and sends to UTRAN. If it is in UE assisted mode, UE sends the LCS related measurement report to RNC (Radio Network Controller) [4-6]. RNC calculates the target UE position with the measure data from the target UE, the stand-alone LMU and Node B respectively. It sends the target UE location information to MSC using location report message. And MSC assembles the location information into "provide subscriber location ack" message to GMLC. GMLC sends LBS service response which contains the target UE location information to external client. Fig. 2 shows the procedure of external client requesting UE location.

(2) The PLMN UE request the target UE location procedure. In this situation, the PLMN UE can request its location or other UE location information. The location procure is similar as Fig. 2 except that the LBS client is PLMN UE instead of external clients. LCS client sends/receives LCS request/response to/from GMLC via Uu, Iu and Lg interfaces other than Le interface.

4 The test scheme of LBS in the TD-SCDMA system

Both the mobile equipments manufacturers and PLMN operators have the responsibility for testing the LBS equipments or network function and performance. Fig. 3 shows the framework of LBS test scheme.

In this framework, the LBS architecture is the same as Fig. 1 but canceling external LBS client entity and

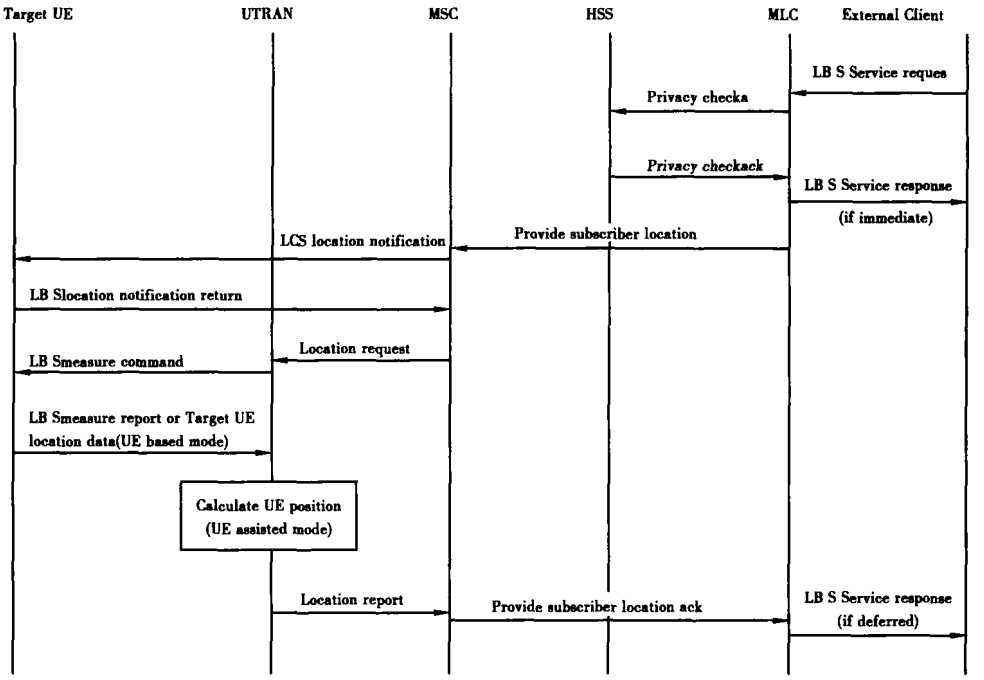

Fig. 2　The procedure of external client requesting UE location

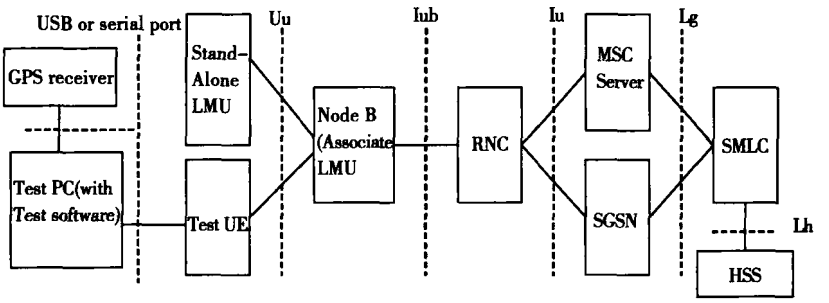

Fig. 3　The framework of LBS test scheme

adding PC module. The test PC (called PC) module takes the role of external LBS clients. GIS softwares are installed on PC so that the interfaces are based on the digital map. LBS test software sends requests to UE and collects the responses. The PC communicates with GPS receiver and UE via standard serial port or USB port.

The test software platform contains fore-program, back-program, test case library, and communication (COM) functional modules. Fore-program implements the user interface, back-program takes charge of data communication between PC and UE. Library module manages LBS test cases invoked by back-program module. COM module implements the fuctions between the UE and PC to establish, maintain and release communication. Fig. 4 shows the functional diagram of the test software.

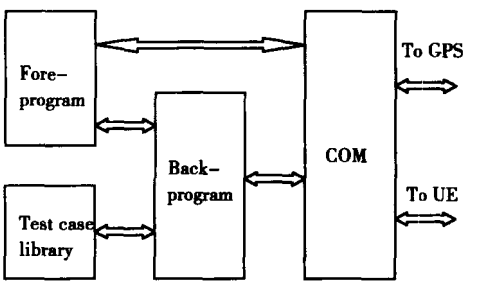

Fig. 4　Functional diagram of test software

5　An example for LBS test flow

For example, a mobile user wants to know his own location. The test procedure is quite straight and shown in Fig. 5. Before testing, making sure that the communication among the PC, UE and GPS receiver with cables are enabled, and all related software works well.

Different types of LBS can be tested when the test case library is enriched, for example in static case, in moving case, using different LDTs, allowing different precision, and so on. A serial of location results are transfered into location curve and precision curve, which reflects the LBS performance to the network operator and equipments manufacturers.

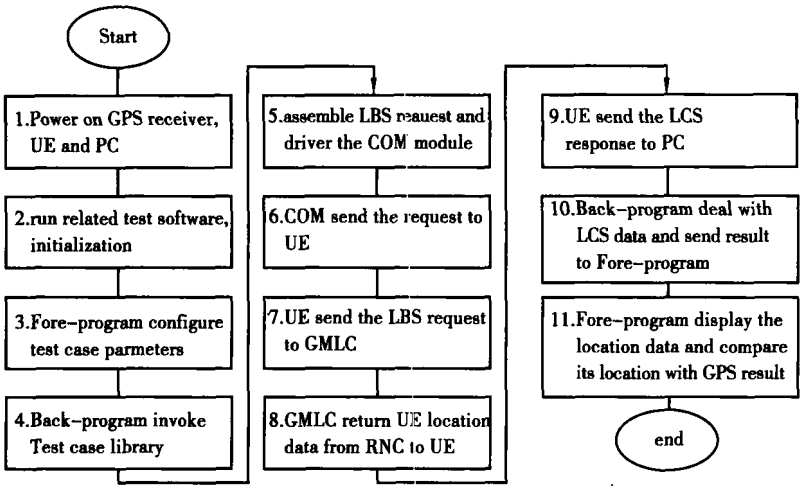

Fig. 5 Test flow of UE requests its own location

6 Conclusion

LBS is an important value-added mobile service. Before commercializing a LBS product, the function and performance test is crucial. According to the industrial standard and core techniques of location based services, a valid and feasible test scheme of LBS in the TD-SCDMA system is proposed, in which the fore-program, back-program, test case library, and communication (COM) functional modules are involved. It is useful for evaluating the LBS performance by the network operator and equipments manufacturers, and finally helpful for optimizing network system.

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基于 TD-SCDMA 系统的 LBS 测试方案

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摘 要: 作为一种重要的移动增值服务, 许多与 LBS 相关的技术已经被提出。功能和性能测试是一项新技术商业化的关键一步, 在这里, 关注基于 TD-SCDMA 系统的 LBS 测试方案, 并设计了 LBS 测试环境和测试流程, 其对于验证 LBS 处理过程和优化网络性能是非常有用的。

关键词: TD-SCDMA 标准; 基于位置的服务; 测试方案

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