# THE STUDY ON GIS-T USED IN MOBILE TERMINALS OF ITS

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**ABSTRACT**
In china, there exists four problems to use common GIS (Geographical Information System) directly in GIS-T (Geographical Information Systems for Transportation). They are: security, real time property, distribution on-line and renovation, and too huge data to be transferred.

In order to solve the secure problem, some fixed and coverable inner storage technologies are adopted in developing the mobile terminals. To solve the real-time problem, the large amount of fundamental information is downloaded by the methods, such as DSRC, of the ITS common information platform, and the relative few of property information from the released platform can be sent to the vehicle through multiple communication modes. To solve the distributed storage problem, the GIS information of another place needs to be downloaded in vehicle with overlay mode. To cope with the large amount of data to be transferred, it converts traditional two-dimension GIS information into one-dimension with the Linear Referencing System (LRS) method which can enhance the road information and impair others.

From the data structure of GIS-T, the above problems are to be overcome.

**Key words:** ITS, GIS-T, mobile terminals, LRS, transportation, event table

Transportation is one of the most important and growing applications of GIS (Fletcher 2000; Wiggins et al 2000). For example, ITS is one of the key fields during the Tenth Five Years' Planning of China (2001~2005). The Ministry of Science and Technology has taken ten cities as ITS demonstration ones in China. These cities begin to construct their transportation information platforms. As the support system of geographical and transportation data in storage and applications, GIS-T is one of the core modules of the platform.

Vehicle and road is the two main entities in the ITS study. The study and application status of GIS-T technology used in ITS mobile terminals directly affects the benefits of the ITS platforms in China.

## 1.Traditional GIS and the GIS-T applied in the ITS mobile terminals

GIS-T is interconnected hardware, software, data, people, organizations and institutional

arrangements for collecting, storing, analyzing and communicating particular types of information about the earth. The particular types of information are transportation systems and geographic regions that affect or are affected by these systems (Fletcher 2000). Many existing GIS have their limited and clumsy representations of transportation features such as an underpass/overpass and relationships such as an intermodal transfer between a commuter rail line and a highway (Spear and Lakshmanan 1998). As a whole from the study and application of GIS-T in China, there exist four problems, when the traditional GIS is directly used in GIS-T. They are:

(1) Security. The China law protects the digital maps of which the precisions are above 1:25K.

(2) Real-time property. The common information platform of ITS (Intelligent Transportation System) requires the system has the real-time property, and can provides real-time transportation and origin-destination information.

(3) Distributed property and renovation in time. Existing equipment in vehicles can only store digital maps of limited region. It is harder to renovate data in time with city construction, than to update the map version periodically. However, when the vehicles get to the new cities, it is necessary to replace the city map with the new one.

(4) The huge data to transferred. The antinomy between the vast download property of huge data, such as digital maps, and the limited download velocity of wireless communication transfer is one of the problems for ITS mobile terminals to solve.

How we get over the four problems directly impacts the function and management of the ITS platform.

**2.The answers for the problems**

-The solution for the security

The fixed and coverable inner storage mediums, secret key, compressing and decompressing technologies are needed in developing the mobile terminals. They can get the basic information of GIS by the multiple download ways.

-The solution for the real-time problem

The equipment of vehicles downloads the large amount of basic information beforehand by the methods, such as DSRC, of the ITS common information platform, and the small quantity of property information can be sent to the equipment in a real-time way from the information release platform by the multiple communication modes.

-The solution for the distributed storage problem

The mobile terminals receive and store new GIS information of another place in the networks with overlay mode.

-The solution for the large amount of data to be stored

We can convert traditional two-dimension GIS information into one-dimension with

the Linear Referencing System (LRS) method which can enhance the road information and impair others.

In general, the basic and efficient way to cope with the problems is to frame a GIS-T data structure. The following will focus on the GIS-T data structure: the transportation events table mainly based on the LRS.

**3.The transportation events table mainly based on the LRS**

LRS data model is one of the key problems in the theoretical study and practical application of GIS-T. LRS includes linear referencing methods, basic linear networks and linear distributed events (including establishments). The linear reference methods refer to how to decide the position of the linear distributed events in the linear networks. The linear reference methods are segmentation reference, address reference, observation point reference and distance reference.

The design of GIS-T database is to make the transportation information into basic road networks and transportation linear distributed events according to the choice of LRS. The basic road networks includes two data tables, number of roads table and control-point table. Both of the tables have geometry items. However, the transportation linear distributed events are represented as property tables, which must have the items required by the LRS, such as distance, address.

The more important is transportation events described by the transportation event table, which is the standard data criterion of transportation events defined by the platform. The criterion is based on GDF4.0 and LRS. The content of the transportation event table is defined in the properties and relationships of the road segments and crossing objects.

Data dictionary, geographical reference data and GIS data make transportation event table objects. In the storage management of transportation event table, multiple indexes are created and the relatively coordinate is built up in the server and mobile terminals.

We set up dynamic transportation event with the changeable self-management table according to the theory of information entropy. The transportation events can be divided into four types.

Table1 the types of transportation events

| transportation events types | EMBODY<br>FIELD | DEFINITION<br>Bytecount | MEMO |
|---|---|---|---|
| basic | Transportation point | 50 | |
| | Other geographical position | | |
| | …… | | |
| | Accident | 100 | |
| | Vehicle-rush-repair | | |

| | | | |
|---|---|---|---|
| common | Traffic-jam | | |
| | Road-rush-repair | | |
| | Service | | |
| | Turn-limit | | |
| | …… | | |
| special | No-entry | 50 | |
| | Special-lane | | |
| | …… | | |
| extended | Accommodation-road | 50 | |
| | …… | | |

When transportation event belongs to one of the four types, there is no data compress in the system. In other cases, we can set different data compress ratio.

Table 2 *Point event table (traffic accidents as examples)*

| Event ID | GID（road ID） | Measure （ position distance） | Time | Other properties |
|---|---|---|---|---|
| | | | | |

Table 3 *Main linear event (the events happened on a segment of the road)*

| Event ID | GID（road ID） | Origin position | Destination position | Time | Congestion direction | Other properties |
|---|---|---|---|---|---|---|
| | | | | | | |

Transport protocols of the event table are the key support of compressing the data volume for transporting, improving efficiency and guarding the data security. The transport protocols definition of the event table mainly includes two parts: basic transport protocols and extended ones. The common text code or XML document can be used for data transporting.

Example 1. Common text code

The code uses coma as the dividing line. The ID of Zhongguancun Street is 10117. the number of the lanes is 8. So the transporting code is as following.

***"event type code，4，RN，LN，TN，DI，10117，8，L0011R1111，8"***

"4" defines that there are four transporting properties. RN, LN, TN, DI are the names of different properties. The following number is the property value. The code defines that there are eight lanes in the Zhongguancun Street, and the first or the second lanes of the left are forbidden to pass, however, others can be got through..

Example 2. XML document

```
<?xml version="1.0" encoding="GB2312" ?>
- <TIP VER "1.0" >
  <CP_INFO CP_ID="02100000001" CP_PWD="123456" GEO-REF GEO-REF="WGS84" UNIT ="M"/>
```

<event type code>051〈/ event type code〉
<RN >10117</RN>
〈LN〉8〈/LN〉
〈TN〉L0011R1111〈/TN〉
〈DI〉8〈/DI〉
</INFO>
</TIP>

Procedure of releasing the transportation events table
After a piece or multi-piece of transportation events tables are transported to the mobile terminals, the application program will decode the tables and change into data structure that can be understood by the application program. Then the event information is related to the spatial objects. Finally, it was represented on the maps.

The design of transportation events tables synthetically uses LRS model, GDF4.0 standard and coding and encoding technologies, and mainly satisfies the needs of GIS in the ITS mobile terminals to solve the real time problem, security problem, too large amount of data, etc.

**4.Conclusion**
The development of LRS model has been one of the core functions of GIS. GDF4.0 and related standards of China are come to mature. Synthetically using these technologies and standards is the efficient method to cope with the challenges which occurs when the traditional GIS is directly used in GIS-T. The paper put forward the transportation event table, which synthetically uses these technologies and standards, tries to make progress in the GIS-T application in the ITS mobile terminals.

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