BYTE-MAP: A NOVEL MOBILE MAP FORMAT USING TWO-BYTE COORDINATES

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1. INTRODUCTION

Mobile SVG, developed by W3C in 2003, is a subset of SVG. Its suitability for embedded devices makes it the most widely used data format in mobile map services. Mobile SVG has two subsets: Mobile SVG Tiny (SVGT) and Mobile SVG Basic. The former is used for low-end mobile facility such as mobile phone, while the latter is used for high-end mobile facility such as PDA. Mobile SVG has many advantages in mobile applications. It is a dynamic and scalable mobile graphic format, and can provide high quality map, support interactive functions. However, Mobile SVG is based on XML, so it still needs lots of tags to identify the attributes. And the geometric attribute of feature is described in real geographic coordinates, which will still result in a vast data volume. Some of the current researches on improving performance of SVG are mainly about how to reduce the number of characters inside the SVG document, such as omitting the common characters of coordinates in an extracted area. Besides, the consumed time in parsing Mobile SVG data and the huge memory cost are not ignorable.

Some researchers presented cGML (compact GML), a compressed version for GML. By using small tags, server side pre-projected and pre-scaled coordinates, cGML allows development and deployment of map-based software for mobile facilities with strong constraints on connections, CPU and memory. However, cGML still has to face the similar challenges with Mobile SVG.

This paper presents Byte-Map, which is a novel mobile map format for mobile map service in mobile devices. Byte-Map is a kind of vector format with different blocks through different levels, and map data of Byte-Map is encapsulated in binary stream. The basic cell of Byte-Map is a block, which is fixed in size of 255 units*255 units according to different coordinates systems and thus the coordinates of all the features in a certain block can be encoded with only two bytes. This paper describes the design idea as well as basic structure of Byte-Map and explains how to apply Byte-Map in mobile online map service. Based on the spatial data of Beijing, we compare the two kinds of data formats, Byte-Map and SVGT, in data volume and handling complexity in mobile terminal. The experiment shows that without data compression, Byte-Map has much less data volume than SVGT. With data compressed for both formats, the data volume in Byte-Map is less than that in SVGT by 35% on average. More ever, the data volume of uncompressed Byte-Map is still a little less than compressed SVGT. Considering the handling complexity in mobile terminal, compared with SVGT and TinyLine, Byte-Map data has less time consume in data decompressing, data parsing and map displaying. Meanwhile, Byte-Map data has much less memory cost. At the same time, we make a series of experiments to compare the performance of Byte-Map itself in different block sizes. The result shows that, due to the large number of blocks, the performance will decrease when handling large scope data. In Byte-Map, we can adjust the coordinate unit for different levels to reduce block number.

2. BYTE-MAP SPECIFICATION

Byte-Map adopts a vector format and its data is encapsulated in binary stream. Also, in Byte-Map, map data is organized in different blocks through different levels.

(1) Level. LOD (Level of Detail) is a common model to organize massive data for visualization. Due to the limited screen size of mobile devices, mobile map data should adopt a same organization mode. The content of map to display should depend on the current scale. With a small scale, it’s sufficient to show only some important features with their rough profiles. So different levels map data should be pre-generated from the original data. Different Levels have different contents in different details to meet the demand of displaying in different map scales.

Requesting map data on demand, that is to say requesting the just level corresponding to the current display scale in mobile terminal, is an effective strategy to save data-downloading time and bandwidth in wireless environment.

(2) Block. The area browsed by mobile users is only a small part of the whole map due to the limited screen size of mobile devices. Hence, it's reasonable to divide the whole map area into blocks, and each block has the same size. Server can only provide the blocks covered by the user's requested area.

Here, the choice of block size is a critical issue. To minimize the data volume, we set the block size as 255 units * 255 units according to different coordinates systems. Let the left-bottom point of a block be the base point, so in a certain block, the value of coordinates x or y is ranged from 0 to 255 according to the base point, which means that we can use only one byte to present x or y.

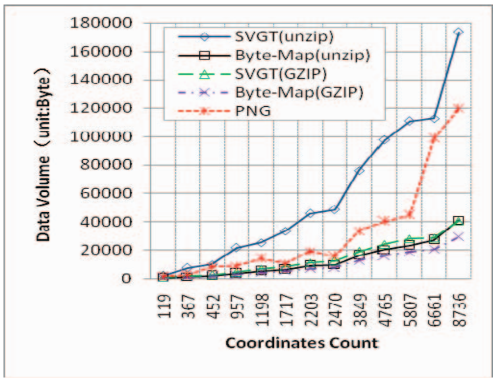
When showing map data of high level (e.g. Level 0), if the scope which one coordinate unit presents is the same as that in low level, the performance will decrease due to the large number of blocks. To avoid this, we can increase the coordinate unit of block. Different coordinate units will be adopted for different levels. For example, we can set "1 meter" to be the coordinate unit of blocks in Level 2, "10 meters" in Level 1 and "100 meters" in Level 0. This kind of adjustment can be executed when needed.

3. USE BYTE-MAP DATA

Based on Byte-Map, we have developed LBS-p, a platform supporting location-based services. Conformed to client-server architecture, LBS-p consists of two parts: LBS-p Mobile and LBS-p Server. LBS-p Mobile can display map by providing some basic map functions, such as moving, zooming, picking, etc. Besides, LBS-p Mobile can send request to LBS-p Server with specified range and levels. Once the LBS-p Server receives the message, it generates a spatial data set in the form of blocks covered by the requested range, encapsulates them in a Byte-Map slice, and then transmits back to LBS-p Mobile.

4. PERFORMANCE EVALUATION

The critical issue of mobile online map service is to try to transmit much less map data and display map with much less response time in mobile terminal. The response time contains the time of data transmission, which is directly related to the map data volume, and the time of data handled in mobile terminal. In this section, we designed several experiments to compare the data volume in different format: Byte-Map, Mobile SVG Tiny (SVGT) and PNG. Also, we compared the handling complexity of Byte-Map data in mobile terminal with that of SVGT. In addition, we made a series of performance evaluations to compare Byte-Map itself in different block sizes.



The right Figure shows one of our evaluation results - the amount of data encapsulated in different formats. SVGT, based on XML, has a large data volume. Usually, in order to save the bandwidth of wireless network, data will be compressed. The average compressing rate of SVGT is about 70.5%, while that of Byte-Map, which is encapsulated in binary stream, is only 20.9%. However, the compressed data of SVGT is still a little more than data of Byte-Map without compressed. With both of the data compressed, the data volume of Byte-Map is less than SVGT by 35% on average.

5. CONCLUSION

Byte-Map is a novel kind of vector format with different blocks through different levels, and Byte-Map data is encapsulated in binary stream. The basic cell of Byte-Map is block, and the coordinates of all the features in a certain block can be encoded with only two bytes.

Performance evaluations show that Byte-Map is superior to Mobile SVGT either in the data volume or in the handling complexity in mobile terminal. At the same time, we take different coordinate units for Byte-Map data of different levels, making the number of blocks still small when displaying large scope map.

LBS-p, based on Byte-Map and supporting location-based services, has evolved well in mobile online map service. It embodies the advantage of Byte-Map, which is less data volume and high performance of data handling in mobile terminal.

6. REFERENCES

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