Urban Traffic Information Service Application Grid

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Abstract Traffic information processing is very complicated because of dynamic, cooperative and distributed features. This paper describes the prototype system version 2.0 of Urban Traffic Information Service Application Grid (UTISAG), which is based on the previous version. In this version, a new architecture and more enhanced services are introduced.

The remarkable characteristic of the new system is providing dynamic information services for travelers by grid technology. Therefore, the key research includes integrating large multi-source traffic data, forecasting route status, simulating regional traffic flow parallelly, and implementing optimum dynamic travel scheme based on massive GPS data.

Keywords application grid, data integration, optimum dynamic path, route status forecasting, traffic information service

1 Introduction

Grid[1,2] became a research focus after Internet and Web because high performance computing technology infiltrated more into Internet technology by the end of 90’s. Grid tries to make it come true that all resources in Internet are overall connected and shared, including supercomputers, storage devices, network, software, information, knowledge, user services, and others.

In USA, grid researches are focused on computing grid and data grid, e.g., TeraGrid[3] and GIG (Global Information Grid).[4] In Europe, grid projects, including DataGrid[5], e-Learning[6] and e-Culture[7], emphasize grid application. In other countries, such as Japan, India, Singapore, South Korea, and so on, some grid programs have been established.

China has also enhanced investment to grid research. At present, some key projects have been supported, e.g., National Grid by 863 program, ChinaGrid project by Ministry of Education (MoE), Network Computing by NSFC, and Shanghai Grid by Shanghai Municipality[8].

Nowadays, Information Service Grid (ISG) is a new application model, which intends to share data, knowledge, software and other kinds of information in Internet. Because these information resources are distributed, dynamic and heterogeneous, ISG provides autonomic, QoS assuring, scalable and dynamic information services for virtual organizations.

ISG can be applied to Intelligent Transportation Systems (ITSs)[9]. Road construction in China is the fastest in the world. However, the traffic capacity of road network cannot match the increasing of traffic flows, and traffic jams are becoming more serious in large cities. There are two main reasons: one is many transportation data cannot be shared and utilized efficiently; the other is transportation management systems cannot support the exact, real-time and dynamic information services. So, using ISG to reconstruct the existing transportation management system is an effective approach to improving traffic capacity and the quality of road network service.

Actually, Shanghai City Transportation Management Bureau (SCTMB) attempts to improve work efficiency and management level by ISG. SCTMB, and its subordinate administrative offices and companies, have already developed their own information systems respectively, e.g., Taxi Transportation Management Systems, Bus Transportation Management Systems and Track Transportation Management Systems. But these systems are isolated so that transportation data cannot be shared. Therefore it is urgent to integrate all isolated systems and develop an overall information service system, a statistic analysis system, a real-time monitoring system, and an assistant decision making system.

At the end of 2003, we began to cooperate with Shanghai City Traffic Information Center (SCTIC). SCTIC provides us with historical and real-time GPS data and implements traffic information services on-demand and information release. The grid nodes of Tongji University and Shanghai Supercomputing Center provide computing support. In August 2004, we developed the prototype system version 2.0 of UTISAG (Urban Traffic Information Service Application Grid) based on the version 1.0[9,10].

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2 Architecture of UTISAG

According to the requirement of the traffic information services, the architecture of UTISAG is divided into four layers as Fig.1 shows.

![Architecture of the Urban Traffic Information Service Application Grid](image)

2.1 Services On-Demand and Information Presentation Layer

This layer provides users with some interfaces of service on-demand and information presentation. These interfaces include two types: the first is based on settled clients such as PCs and touch screens; the second is based on mobile terminals such as Gdson CPU in-vehicle terminals, PDAs and mobile phones.

Because PCs or PC-like clients have higher configuration of software and hardware, and communicate through cable network, they use B/S model interface. The mobile clients have lower configuration and communicate wirelessly through CDMA, GPRS or GSM, hence they have their special client software which is fixed locally.

2.2 Traffic Application Service Layer

This layer integrates traffic application services. They are divided into two parts: one is the traveler services for common users; the other is the management services for traffic running management departments.

The main functions of the traveler services include:

1) Route status service. It supports real-time route status query (key route status, specified region, or specified route), historical route status query, route status forecasting, etc. Three colors are used for route status: red is for congestion, green for smoothness, and yellow for intermediate state.

2) Optimum travel scheme service. In this service, the query of shortest distance path and minimum time path is available.

3) Public facility query service. It shows the dynamic information of parking lots, gas stations, vehicle repairing places and other facilities. For example, a driver can use park query to find a parking lot near his destination with an unoccupied space.

2.3 Grid Service Support Layer

In order to support Traffic Application Service Layer, this layer provides Task Scheduling, Resource Management, Data Management, and other grid services. The Task Scheduling service assigns computing tasks to corresponding grid nodes. Resource Management takes charge of monitoring and scheduling local resources. Here, the method of resource discovery of VEGA is used\cite{11}. Data Management supports accessing to heterogeneous databases and transferring massive traffic data.

2.4 Resource Layer

In this layer, there are computers and storage devices in ShanghaiGrid and SPTN (Shanghai Private Traffic Network). As software resources, many existing transportation systems and heterogeneous databases in SPTN also lie in the layer. Besides above resources, the program code library and the traffic model library are deployed on corresponding nodes.

3 Implementation of the Prototype System

3.1 Organization of the Grid Nodes

The nodes of UTISAG include two parts as Fig.2 shows. One is SPTN, and the other is ShanghaiGrid. The nodes in SPTN are interconnected by 100M private lines. SPTN provides not only traffic data for the grid, but also the information on-demand and presentation platform of UTISAG. The nodes in ShanghaiGrid are interconnected by Internet. They provide computing resource and storage resource for UTISAG. Especially, as the further processing platform of traffic data, the Tongji University node connecting with SCTIC, makes SPTN and ShanghaiGrid form UTISAG together.

3.2 Implementation Scheme

Application system consists of three parts: 1) real time traffic data acquisition; 2) the platform of services on demand and information releasing; and 3) the center of traffic data processing and service supporting. The implementation scheme is shown in Fig.3.