

## RAILWAY TICKETING AND RESERVATION SYSTEM IN CHINA

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**abstract:** Based on analysis of the passenger transportation operations and traffic volume in Chinese Railway, the paper presents the Railway Ticketing and Reservation System in China. What are the main goals of the system in short term and long term. How does the general structure of the system look like? After studying advantage and disadvantage of three system structure modes, the paper recommends the centralized and distributed system combination mode according to Chinese Railway situation. Finally, the function architecture of the system is generally designed in the paper.

### 1. INTRODUCTION

Railway, as the "main artery" of national economy, is the backbone of the transport and traffic systems in China for both freight and passenger transportation.

Chinese railway has more than 5,000 passenger stations, including 1120 stations of first three classes. The railway sells more than 3 million tickets every day in average, and the annual passenger volume is about 1,000 million person-times.

Although the amount of ticket sold in railway is very huge, the method of ticketing and reservation is quite traditional and backward, the ticketing operation is still done manually with low speed, and keeping passengers in waiting queue for long time. While people are complaining about the difficulty for buying tickets, the trains still have seats unused, and the transport capacity of the train is wasted.

Since in recent years economy has grown rapidly and people's living standard is getting higher and higher in China, the requirement to the railway both in the transport capacity and service quality is enhanced enormously. The rapid development of highway and civil aviation in China is making the railway facing the competition stronger than ever in the passenger transportation. All these facts make it an urgent task for Chinese railway to build the ticketing and reservation system.

### 2. SYSTEM GOALS

The final goal of the system is to build a computer network covering the whole railway in China, realizing the modernization of ticket selling and management. It will be the

largest system of railway ticketing and reservation systems in the world with full functions and advanced technology.

- First, the computer ticketing system will be realized in networking at stations where the inter-city and express trains stop. At every ticketing counter in Chinese railway can sell tickets for any trains in any directions.
- The system can sell tickets of the current day and the coming days, and make reservation of tickets for single, return and transit trip for passengers at any stations.
- The pre-sell period of the system is 30 days, the reservation period is 180 days.
- The system will provide managers and decision makers in all levels with DSS to enhance the management and service of passenger transportation.

As soon as the basic system is built, its functions will be farther improved as followings:

- To establish the auto- ticket-check system at large stations.
- To establish the vendor machine system to sell tickets of some trains.
- To establish extended service system , realizing the interconnection of tour agency, hotel, bank, aviation agency with the system.
- To connect with international railway ticketing systems.

### 3. TRAFFIC ANALYSES IN THE SYSTEM

#### 3.1 Stations in the System

The railway in China has more than 5000 stations in different classes. It is impossible and unnecessary to put them all into the system. Considering the traffic volume , geographical position, political and economical position, communication and networking condition of stations, only parts of them where the express trains may stop for passenger getting on or off could be included in the system at present .According to the statistics of “the railway passenger train schedule”in 1996,the number of stations of this kind is 1771, and the distribution of these stations in railway administrations is shown in Table 1.

Table 1. Number of station in administrations

name of administration	number of station	name of administration	number of station
Harbin	282	Shengyang	293
Beijing	229	Zhengzhou	217
Shanghai	206	Chengdu	138
Guangzhou	117	Jinan	82
Huhehaote	48	Lanzhou	72
Wurumuqi	35	Liuzhou	54
total	1771		

### 3.2 Passenger Traffic Volume in the System

According to statistics in 1995 and predicting data in 2000, the total passenger traffic volume achieved by 12 railway administrations is shown in Table 2.

Table 2. Total traffic volume by administrations unit: 1000 person

name of administration	departure volume/day		name of administration	departure volume/day	
	1995	2000		1995	2000
Harbin	354	476	Shengyang	626	842
Beijing	378	508	Zhengzhou	258	347
Shanghai	467	628	Chengdu	189	254
Guangzhou	250	336	Jinan	119	160
Huhehaote	27	36	Lanzhou	37	50
Wurumuqi	16	22	Liuzhou	74	99

As mentioned above, the system will cover 1771 stations, which only take a percentage of about 35.4% of total number of stations in Chinese railway. However, they handle 86.6% of total passenger traffic volume, that is: 2,420,481 tickets sold by them per day in 1995 and 3,254,848 in 2000. The number of passenger departed at those stations in different administrations is shown in Table 3.

Table 3. number of passenger departed at ticketing stations unit: 1000 person

name of administration	departure volume/day		name of administration	departure volume/day	
	1995	2000		1995	2000
Harbin	312	420	Shengyang	698	669
Beijing	333	447	Zhengzhou	237	319
Shanghai	428	576	Chengdu	150	202
Guangzhou	219	294	Jinan	107	144
Huhehaote	24	32	Lanzhou	33	44
Wurumuqi	15	20	Liuzhou	63	85

## 4. THE SYSTEM ARCHITECTURAL STRUCTURE

### 4.1 The Major Factors Affecting System Structure

The architecture of the railway ticketing and reservation system is affected by many factors, major ones of them are as following:

- The passenger traffic volume and its distribution in the railway
- The city planning and the administrative system

- The railway communication facilities and communication network structure
- The characteristics of railway ticketing and reservation operations and their flow

#### 4.2 Analysis on Major Operations in the System

The railway ticketing and reservation are one of the most important tasks of railway passenger transportation, and it is a complicated comprehensive system both for commercial business and information management as well. Generally speaking, the major operations of the system for Chinese railway could be classified into four categories as following:

- window operations

It includes operations with characteristic of high real time and parallelism, such as ticket selling and reservation, tickets cancel and passenger inquiry. The maximal system response time for one passenger service transaction should be less than 7 seconds.

In Chinese railway, every ticket should be associated with the coach and seat number, no matter for inter-city trains or for local trains. So, seat number management and assignment are the kernel of the system from technical point of view.

- passenger transportation statistics

The passenger transportation statistics are a batch processing operation based on the previous operation. It consists of day-, ten day- and month-statistics for traffic volume and financial income.

- Business accounting

In Chinese railway, sub-administration is an accounting unit, and accounting operation is done in day, ten-day and year respectively. The most important thing for accounting work is to guarantee absolutely safety and secrecy of crucial data.

- planning and scheduling operation

The ticket assignment is one of the main tasks of passenger transportation planning. Due to transportation capability being less than transport request, the limitation of ticket quantity that every station can sell for each train should be made by Railway Ministry and Administrations respectively based on the capacity of passenger train and data from Passenger Flow Graph. The scheduling operation related to ticketing and reservation contains the making, transferring and implementing of scheduling instructions by adding, canceling trains, and adding, reducing or exchanging cars in the train and so on.

#### 4.3 The General Structure of the System

The crucial problem exists in the structure design of the ticketing and reservation system is the decision on the number and location of seat databases in the railway

network. Considering the existing passenger operation regulations and the transaction data flow in the system, the communication capacity of computer network, we analyze and compare three major system structures.

### 4.3.1 Centralized Structure

In centralized structure, there is only one central database that contains the following data:

- seat data for all trains in system

Seat data set is a real-time processing data with huge amount that can be calculated as following:

$$Q=N*M*T*L$$

where :

N--the number of passenger trains

M--average number of seat in a passenger train

T --the length of reservation period

L --the length of a seat data record

- railway-net data
- train-time schedule data
- tariff data

When the reservation or ticketing operation is made at any station counter window, it is necessary to get seat status data from the central database via X.25 network. The system structure is described in Figure 1.

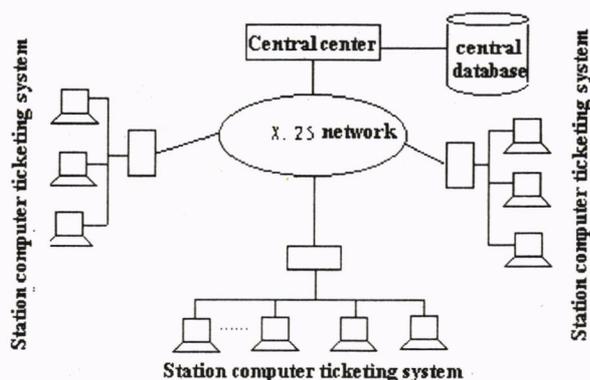


Figure 1 Centralized System Structure

The centralized system has lots of merits, such as simple structure, good consistence and integrity of data, convenient for the transit-ticket, return-trip ticket and seat re-usage. But due to the concentration of the all data into one central database, the proper operation and performance of the system depend greatly on the high quality of

mainframe and a perfect computer network. In addition, the system construction period is relatively long, and not suitable to be realized and put in operation step by step.

#### 4.3.2 Distributed Structure

In distributed system structure, no longer exist a central database, and all the data mentioned above are distributed to local databases of originating stations where trains are assembled and depart originally. The structure of this scheme is shown in Figure 2.

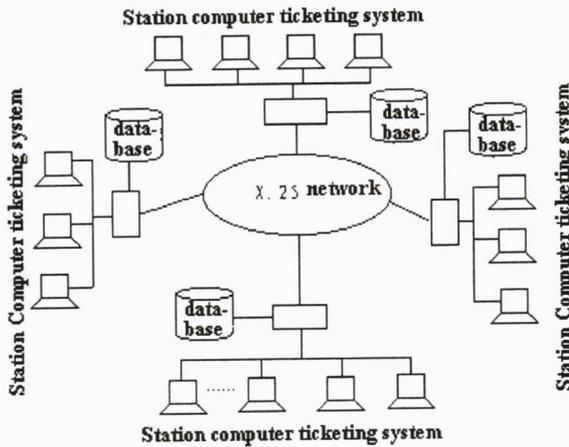


Figure 2. Distributed System Structure

Distributed system is easy to be implemented and put in operation step by step, and because all the seat data are stored in their departure stations, the traffic volume and the expenditure of communication in network is relatively low, and the response to ticketing and reservation transaction is very rapid. However, the biggest trouble of distributed system is the consistence and integrity of data in distributed databases, what's more, a transit-ticket or return ticket selling transaction needs to access two or more databases to get the required seat data, and seat re-usage is very difficult to process.

#### 4.3.3 Centralized-distributed Structure

Combining the structure of centralized system and distributed system, this scheme will have one central database with basic data which are railway-net data, train-time schedule data, tariff data and etc., and several regional databases with seat data for trains which are assembled and depart in these regions. The structure of centralized-distributed scheme is shown in Figure 3.

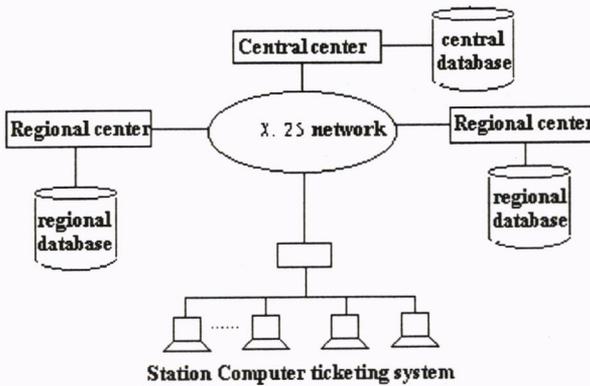


Figure 3. Centralized-Distributed System Structure

Centralized-distributed design combines the merits of both centralized system and distributed system, that is, convenience for return ticket and transit ticket selling, for seat re-usage and information sharing, and in addition, reducing the communication expenditure effectively, the investment of the system being rational, upgrading and replacing of equipment easily. Also this design can well adapt to the administrative reform for its elasticity and adaptability.

Considering the railway network, the railway passenger management system, and the status of the communication infrastructure in China, we think that centralized-distributed structure is the suitable design for Chinese railway nowadays.

On the principle of the balance of traffic volume, train number and express train ticketing station's distribution in the administrations of Chinese Railway, we made analysis and research using the Multi-indices Comprehensive Evaluation System. The conclusion of the research is that one central database (central center) and 27 regional databases (regional centers) should be built in Chinese Railway ticketing and reservation system.

**5. THE SYSTEM FUNCTIONS**

From the view of application functions, the ticketing and reservation system can be divided into six subsystems, as shown in Figure 4.

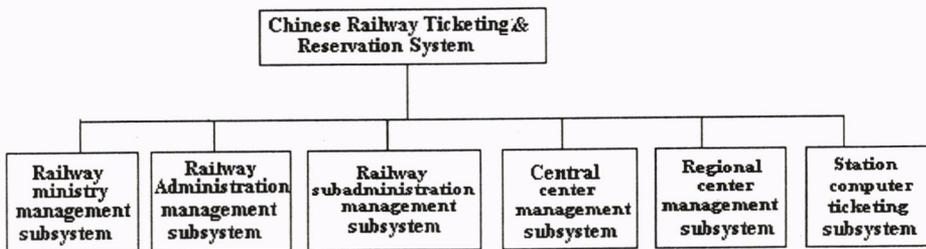


Figure 4 the system function structure

They are:

- Railway ministry management subsystem
- Railway administration management subsystem
- Railway sub-administration management subsystem
- Central center management subsystem
- Regional center management subsystem
- Station subsystem

### 5.1 Central Center Management Subsystem

The functions of central center management subsystem is mainly to maintain the basic data set for the whole system, allocating the tickets of some key trains among main stations, working out the plan and adjustment of passenger trains, inquiring data about the passenger transportation situation by railway managers and decision makers, Communication network supervising and controlling, safety management and interconnection with foreign systems, seen in Figure 5.

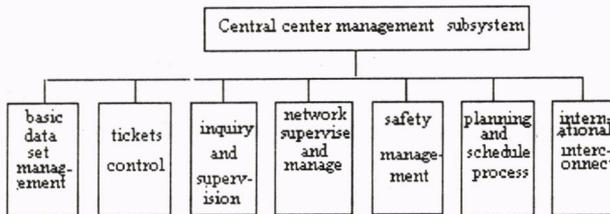


Figure 5. Central Center Subsystem Functions

### 5.2 Regional Center Management Subsystem

The main functions of the regional center are maintaining and managing the basic information downloaded by the center above, accessing and managing the seat data of trains belonging to the region, tickets allocation and regulation to stations in the region for local trains, region network supervising and managing, safety management, financial business controlling, and train operation plan implement or adjustment, seen in Figure 6.

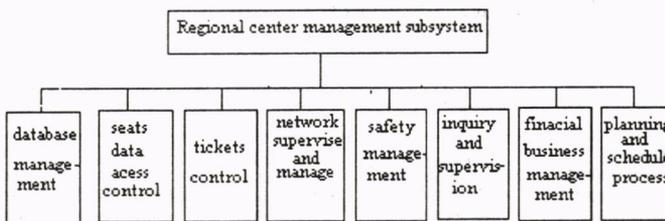


Figure 6. Regional center functions

### 5.3 Railway Ministry Management Subsystem

The railway ministry is the top administrative department of railway transportation. The main functions of the subsystem include: transportation & finance statistic and analysis, estimate prediction of traffic volume and income, planning and adjusting of train operation in railway-wide, inquiry and supervision of passenger transportation situation, seen in Figure 7.

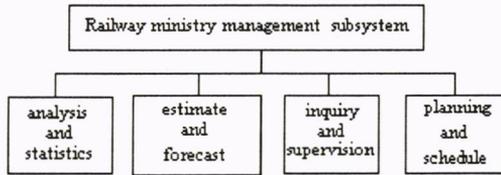


Figure 7. Railway ministry subsystem functions

### 5.4 Railway Administration / Sub-Administration Management Subsystem

Basically, the functions of the railway administration and sub-administration are similar to each other. They are shown in Figure 8.

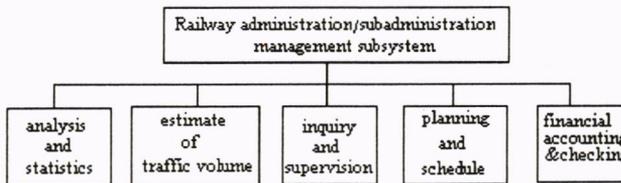


Figure 8. Administration / Sub-administration subsystem

### 6.5 Station Subsystem

The station subsystem is the most important part and at bottom of the system. It is of both real-time processing of commercial transaction and MIS system with client oriented from application function point of view. The main requirement to the station subsystem is to serve quickly passengers with convenience and error free.

The main functions of the subsystem are as followings:

- Ticket selling and reservation : The passenger gives the request parameters for tickets, such as travel date, ticket kind (class), departure and arrival stations, with or without train number and other special requirements. Then the system works out the train number, coach seat number, departure and arrival time, ticket price, and finally print legal tickets.

- Ticket canceling and seat retrieve : At several hours before the train leaves, passengers may request ticket canceled, then the system calculates the fee for ticket canceling and retrieve the coach and seat number to the database for re-usage.
- Passenger transportation plan and management : according to the transport order and plan given by management levels above, the system generates and / or modify the seat database and ticket allocation scheme.
- Transport and finance statistic.
- Financial accounting.
- Ticket stock management.
- Subsystem control and supervision.

## 6. CONCLUSION

The Chinese Railway Ticketing and Reservation System has three level hierarchy with client / server mode. In period of three years, the system will establish one central center, about 27 regional centers and 1771 stations equipped with computerized ticketing system. The system construction plan has been implementing step by step from bottom to top since the beginning of 1996. Now more than 100 stations have already built the computerized ticketing system and one regional center has been established. When the system is full completed , it will be the largest railway ticketing and reservation system with high technology in the world.

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