Supervision and Operation Decision Support Platform for Urban Rail Transit

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Abstract—**This paper proposed approach of integrating supervision alarms and trains located on the map to support emergency management of urban rail transit network. The characteristics of dynamic passenger flow are analyzed to figure out transfer coordination and evacuation schema, related algorithm is developed. Information sharing is discussed and method of connection timetable optimization for metro and other traffic tools are introduced in hub. Explored technologies are applied in supervision and operation decision support platform, with introducing hierarchical structure for data exchange and applications. Implementation of the technical system shows its effectiveness in emergency treatment and rescue resource collocation in time.**

Index Terms—**urban rail transit; emergency management; information sharing; supervision; decision support**

I. Introduction

In recent years, multiple metro lines are connected and more complex urban rail transit (URT) network is emerging. Relative separated space, crowded passengers, and complicated equipment increase possibility of accident in URT caused by potential factors such as equipment failure, natural disasters, especially in their randomness, dissemination, and diffusivity within urban rail net. In order to avoid or reduce the loss of accident, measures and technologies are employed. Safety greatly depends on disaster preparedness and emergency measures. Pertinently supervising danger zone and facilities by installing sensor devices can improve reliability [1]. Emergency management visualization with hypermedia digital application [2, 3] and available equipments position by employing GIS technologies [4] can assist emergency decision [5, 6]. The safety analysis for dependable system is also researched to improve reliability of these tools [7]. To date, integrated supervision and control system (ISCS) has been installed in stations to monitor running situation of equipment and alarm while malfunction occurred [8]. ISCS of each rail line can deal with simple faults or running with them, relying on its self-fitness performance, whereas it is difficult to organize rescue activities like information collection, making decision, and resource deployment. Emergency plan is urgently required in context of disaster as well as information need to be integrated. Once accident happened, dynamic changes of passengers would lead to congest in short time if operation decision scheme is not be make out efficiently. Adjustment of timetable in urgent period of accident is necessary, especially in transfer hub, which requires excellent algorithms and data analysis of running trains. To meet these challenges, advanced supervision in real-time is introduced in the process of accident treatment, and the platform aiming at supervision information sharing and decision support is presented.

Typical problems needed to be confronted in the information disposing platform can be collected as follows: (1) More transfer hubs caused dynamic passenger flow between metro lines, which further leads to difficulties of transport capacity allocation. (2) Corresponding to multiple metro agencies, cooperation and resource sharing serve as another requirement in the new mode of management, e.g. sharing of power substation for several URT lines. (3) How to utilize information collection and act as crucial resource to assist emergency rescue. (4) Deployment of rescue resource, like Aid teams or rescue tools, is a basic factor for accident treatment, as well as coordination with other traffic tools for passenger evacuation, and corresponding information is necessary.

Thus, concerning complexity and characteristics of URT operation, hierarchical structure theory of system engineering is introduced to establish respective coordination between rail lines. Depending on location details and route programming of GIS technologies, location of every train on rails could be calculated to match on signal sections, which acts as basis to simulate trains motivation in real-time, then pre-alarm for interruption and delay could be further attained through definitely algorithms. The information sharing strategy serves as crucial method to build efficiently utility of supervision data analysis. Also, passenger quantities and distribution orientation are chosen as basic factors to figure out rational result of composite coordination in the background of evacuation among different types of traffic tool.

The research outcome has been converted into an information platform for safety and emergency

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preparedness in URT system. It indicates the needs of operation and emergency concern more information utilization, including supervision, dynamic passenger statistics, and allocation of rescue resource on the map. Pre-alarm for part of URT network contributes more on reducing damage and establish evacuation scheme by collecting and analyzing supervision information of equipments and trains.

II. Supervision Information of URT Network

A. Derivative of Alarm Information

Supervision system collects all sorts of status from device monitors installed in stations or trains, and gives out alarm above definite grade, such as overrun alarm of electric voltage and current of main devices in core substation, breakdown of key equipment like drainage system or exhaust fan in tunnel, fire alarm, etc. Concerning complexity of monitor system caused by its large amount of types, the strategy of hierarchical classification is introduced to identify extent of alarms. The classification is defined as equipment “type, catalog and group”. “The types” is corresponding to public area of station, and every type is related to multiple “catalog”, which matches with location like station hall. “The grades” associates with equipment status. As system and equipment have respective alarm threshold, we set index of pre-alarm which links to judge rules for emergency response. Defines index Δ_i as alarm grade, so

$\Delta_i = \begin{cases} 0 & normal \\ 1 & low-level \\ 2 & high-level \end{cases}$, alarm for low or high level like Power Supervision Control and Data Acquisition System (PSCADA).

$\Delta_i = \begin{cases} 0 & normal \\ 1 & alarm \end{cases}$,only for two values like Fire Alarm System (FAS).

$\Delta_i = \begin{cases} 0 & alarm \\ 1 & \Delta_{ij} \in [1,2,3,4,5] \end{cases}$Alarm grade can be divided into five types.

$\Delta_i = \begin{cases} 0 & normal \\ 1 & alarm \end{cases}$ Alarm points to manual settings.

Every cycle of system scanning will be execute full record scanning until the index points to manual settings and scanning end, with marking one cycle is over. If index $\exists\Delta_i = 1$, set mark as 1, which implies the equipment alarm appear. According to index grade, $\exists\Delta_i > 0$ and $\Delta_i \geq \eta$, η means predefined advanced alarm, so the alarm reaches danger level and emergency response is started.

The level of alarm is identified as different value in these supervision systems, especially in PSCADA and FAS.Pre-alarm for PSCADA includes voltage and current of electric switches and their protected operation, while they are beyond of normal range. So rating values for voltage and current are defined as u_0 and I_0 in respective, then low or high level can be counted based on percentage of fluctuating range. It defines

$$u^+ = u_0(1+p\%), u^- = u_0(1-p\%)$$

p uses as default value 10%, of course it also can be modified by system user. While pre-alarm appears, corresponding switches and their attributes will be searched, e.g. name, number, transformer substation which belongs to, etc.

Alarm in FAS abides by divided area principle that fire protected subarea sets out alarm message whenever any fire sensor detects fire signal, which lies in the zone of subarea. Especially, the partition for these subareas in FAS system is consistent to fire management area at station, more often, equipment room or independent space are treated as certain subarea. Thus, station is composed of many fire protected subareas, which secures accurate fire alarm for stations in FAS system is achieved. The set of subareas is described as $f(i) = \{f_1, f_2, \cdots, f_i, \cdots, f_n\}$, means the subarea includes n fire sensors. Also, set of station can be defined as

$$s(j) = \{s_1(f), s_2(f), \cdots, s_j(f), \cdots, s_m(f)\} \tag{1}$$

It means there are m subareas in the station. If $f_i = 0$, then sensor i sent out fire alarm. So, if $f \wedge s = 0$, then fire alarm is true and a alarm message is activated on system screen.

To be more important, the multi-level matched with multi-category is pointed out in alarm supervision analysis. In detail, all sorts of alarms exists in sensors show different characters and extent. Concerning variety of alarms, the four-grade alarm is defined to identify how importance and urgency is and which kind of response should be started.

First-grade: the most emergent alarm, which is often related to lose lives or destroy of URT, e.g. abnormal in the circumstances of train running, fire in station or train, etc.

Second-grade: momentous accident that leading to interrupt normal transportation for definite time, such as electricity fault of crucial equipment.

Third-grade: serious accident or great equipment malfunction, which require dispose in time to avoid interfering trains running.

Fourth-grade: common malfunction that may bring about accident, for example, super-high beyond water line in pump.

B. Train Supervision and Real-time Positioning

The status of train is basic information of URT network operation, as well as it includes arrival time, departure time and stuck alarm in tunnel. Applying real-time positioning techniques, motivation of trains can be shown on map with timetable of current train. Also, visualized collocation of rescue resource adopts devices location with their features to attain emergency and coordination with other traffic tools, based on geography information. Hierarchical structure is applied to describe motivating trains and their relations.

Trains are defined as triple array $\mathrm{M} = \{\Pi, E, \Phi\}$. Π is first step to present all trains on the line, containing individual attributes like train number, order, train type, direction etc. E is second step to token stations followed by every train, which relate to station name, arrival time, and departure time of corresponding train. Π and E are bond to hierarchical structure. Φ means attribute of train, e.g. loading rate, train type, capacity. Define lines set L to certain transfer station as $L = \{l_1, \cdots, l_i, \cdots, l_m\}$. Therefore, all of trains in line l_i can be expressed as $\Pi'(l_i) = \{\Pi_1, \Pi_2, \cdots, \Pi_j, \cdots, \Pi_n\}$, ε_h means transfer station. All trains are totaled as

$$\Omega = \sum_{i=1}^{m} L\left(\sum_{j=1}^{n} \Pi\left(\sum_{k=1}^{z} E(\varepsilon_k)\right)\right) \tag{2}$$

Principle of train positioning on map is called "double corresponding law", which means real-time train location relates to rail section position, and further corresponds to coordinate of longitude and latitude on the map [9]. Especially, some of sections like turnout, in and out of storage, and area of multiple platforms, have appropriate relation that one location relates to several rail tracks. Pick up the milestones at center of station as the base point, thus we can calculate trains location on the map. In order to separate train location from each other in rail layout, we divide sections into types to build mapping sections and milestones as Figure1.

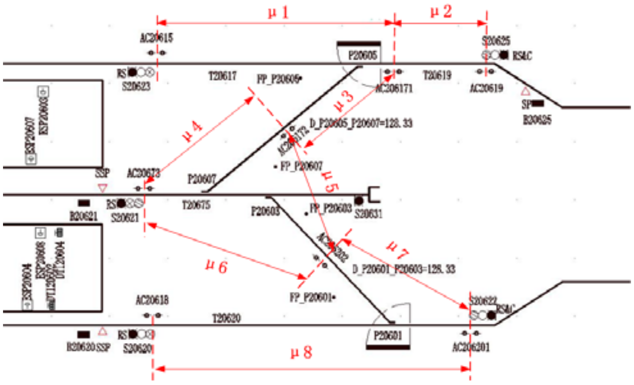

Figure1. Principle of train positioning

So $r(\mu)$ is expressed as mileage for section μ, and E_{l_i} is station set, while total mileages can be tailored as

$$R_{l_i} = \sum_{\varepsilon=1}^{z}\left(\sum_{\mu' \in [\varepsilon_a \to \varepsilon_b]} r(\mu')\theta + \sum_{\mu'' \in [\varepsilon_a \to \varepsilon_b]} r(\mu'')\theta\right) \tag{3}$$

$\varepsilon_a, \varepsilon_b \in E_z$ θ is variable of 0 or 1, if it is in region of turnout then $\theta = 1$, else $\theta = 0$. As the analysis result, actual totaled mileages of a train must not be smaller than the difference value from the first station to the last anyway $R_{l_i} \geq r(l_i)$. Thus, calculated location μ and θ can be used to obtain spatial orientation on the map.

The Auto Transit Control system (ATC) is often used to inspect and direct trains in URT nowadays, but demander of transportation has no way to realize fault or malfunction of trains beforehand, in spite of auto transit protecting system is employed to prevent crush between sequent trains. In order to solve this problem, real-time calculation and estimation are combined to find location of trains actually to recognize their displacement through GIS technologies for pre-alarm of trains. The pre-alarm estimation should be divided into two aspects:

- Alarm for train stop in the range of sequent stations.

In normal, train stops in section without demand from transport managers will be regarded as abnormal. The interval of collect data of trains from Automatic Train Supervision system (ATS) is defined as t_c, the default value is set as 0.5 seconds. The location of train related to section of track can be converted as GIS coordinate (x_O, y_O), and the updated location is (x^T, y^T) in the next interval of collecting data after the train running for the same time. If $y_O = y^T$, $\bar{v}t_c \neq 0$, then $\tau = 1$, else $\tau = 0$. τ is used to expressed as alarm for train, and $\bar{v}$ is average speed of train which running in this section of rail track.

In specific, it means once a train has not any displacement in intervals, the system thinks the train is non-normal status and corresponding alarm is put out. The module of alarm for train stop in sections is shown in Figure2.

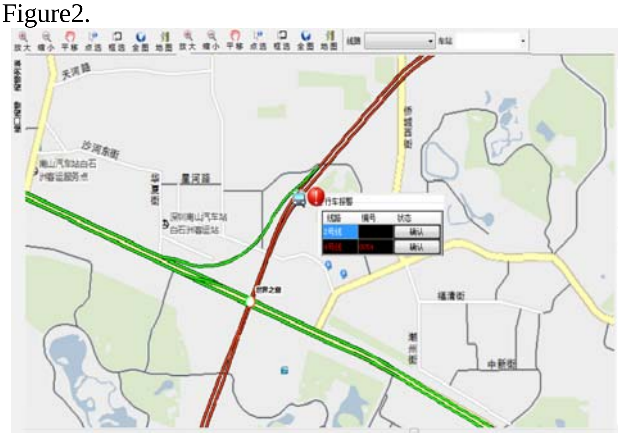

Figure2. Alarm estimation of train movement in sections

- Pre-alarm for timeout of train stop in station.

The parameter is defined as t_{stop}, to determine whether a train stop beyond normal time or not, which default time is 5minutes. The coordinates of start point and end point of a station are meet for $x_i \in [X_s, X_e]$, $y_i \in [Y_s, Y_e]$, and all track sections, described as set $\mu(S) = \{\mu_1, \mu_2, \cdots \mu_s\}$, are in range of the station. If $nt_c > t_{stop}$, $n = 1,2,3,\cdots$, $x^{\mathrm{T}} \in [X_s, X_e]$, $y^T \in [Y_s, Y_e]$, and $\mu^T \in \mu(S)$, then the train has not leave the station in time of t_{stop}. According to estimation of train movement distance, we can achieve outcome of alarm for stop timeout.

III. Dynamic Analysis for Passenger Flow

The statistic for passengers, based on Orientation and Destination (called O-D) station, is counted for any station, according to units of time. In time of t, getting in passengers as $p_{e_k}^{O} = \sum_{t_0}^{t} p_0^O$, and leaving as $p_{e_k}^{D} = \sum_{t_0}^{t} p_0^D$.

The number of transfer passengers serves as important reference to identify passenger density, in order to adjust train plan like increasing or reducing train numbers on lines. Define route set $\Delta_{O\to D} = \{\Delta_1, \Delta_2, \cdots, \Delta_i, \cdots\}$, weight $W = \{\omega_1, \omega_2, \cdots, \omega_i, \cdots\}$, means route Δ_i has weight of ω_i. The weight is related to clearing algorithm between lines, which considering factors of the shortest route, time, and economic, applying fare clearing rate here.

Define $p_{\varepsilon_k}^{HI}$ as transfer passengers, from station array ε_1 to ε_k in order, and $p_{\varepsilon_k}^{HO}$ as those of transfer out of station ε_k from station array ε_h to ε_z. So at the range of T_a to T_b, totaled numbers of transfer passenger as

$$p_{\varepsilon_h}^{t} = \sum_{t_0}^{t} \sum_{\varepsilon_k \in [\varepsilon_1, \varepsilon_h)} p_{\varepsilon_k}^{HI} + \sum_{t_0}^{t} \sum_{\varepsilon_k \in (\varepsilon_h, \varepsilon_z]} p_{\varepsilon_k}^{HO} \quad (4)$$

As far as passengers in hub are concerned, coordination passenger flow can be calculated by AFC record. However, transfer passengers from other traffic tools, related to reach rate of specified tools, can be divided as three cases:

- Possessing cards. It is counted by loading passengers of every reach of vehicles with planned cycling timetables, fitting for direct transfer without pay again. Those of passengers cards which need pay again will be counted for another time.
- Without cards. Reach of these passengers is treated as random variable, through simulating normal distribution.

Therefore, total of passengers is expressed as

$$P_H = \sum_{t_0}^{t} p_0^O + \sum_{t_0}^{t} \sum_{\varepsilon_k \in [\varepsilon_1, \varepsilon_h)} p_{\varepsilon_k}^{HI} + \sum_{t_0}^{t} \sum_{\varepsilon_k \in (\varepsilon_h, \varepsilon_z]} p_{\varepsilon_k}^{HO} \quad (5)$$

It contains three values: entering passengers, transfer passengers between rail lines, and transfer passengers from other traffic tools.

IV. TRAFFIC COORDINATION

A. Coordination between URT Lines

Transfer hub is often called "the bottle neck" for transport operation to meet for requirement of passengers. In order to ease passenger flow in short time, enough transport capacity for transfer hub is needed [10, 11]. In the time set $[T_a, T_b]$, cycle of trains are set as $\Pi'(l_i) = \{\Pi_1, \cdots, \Pi_x, \cdots, \Pi_n\}$, reach time is t_x^D, and leave time t_x^F. In direction of up and down, transport capacity within $[T_a, T_b]$ of trains via the hub is expressed as

$$Q_H = \sum_{l_i \in L} \sum_{t_0 \in [T_a, T_b]} \left(\sum_{i=\Pi_1}^{\Pi_n^{up}} c_i^{up} s_i^{up} v_i^{up} + \sum_{i=\Pi_1}^{\Pi_n^{down}} c_i^{down} s_i^{down} v_i^{down} \right) \quad (6)$$

L is transfer station set, c_i is basic capacity of vehicle, s_i is group number, v_i is loading ratio from ATS. So θ is called the transport coordination proportion to describe the ratio of transport capacity and passenger flow.

$$\theta = Q_H / P_H \quad (7)$$

$$P_H(t_x) = \sum_{t_x \in [T_a, T_b]} p_H(t_x) \quad (8)$$

If $\theta > 1$ then the capacity can meet for the requirement, and while the larger the value that can transport more.

Thus, the model of transport coordination optimization is built as below:

$$\min f = \min |Q_H - P_H| \quad (9)$$

Constraint $t_{l_i G}^{up} \ge t_G^{\min}$, $t_{l_i G}^{down} \ge t_G^{\min}$; $t_0, t_x \in [T_a, T_b]$;

$t_x^D \ge T_a$, $t_x^F \ge T_a$, $t_x^D \le T_b$, $t_x^F \le T_b$

Parameters are predefined to evaluate effect that make it possible to analyzing and controlling vehicles deployment, especially in passenger flow peak or special period like city celebration.

B. Connection with Other Traffic Tools

URT transfer hubs are often connected to the main road in city as well as passenger distribution center links to passenger flow channel in town or suburb. Relatively, those linked traffic tools include bus, taxi, plane, and ship. The connection gives rise a problem for operation that how to integrate different timetable for respective traffic tools without losing cost. The rule that connecting time and density should be preplanned focusing on regular passenger flow is proposed.

In the condition of emergency, temporal bus and more intensive vehicles will be added, while dynamic information is used to organize connection plan, in order to achieve most effective route for evacuation. Define routes set as $\Delta_{O\to D} = \{\Delta_1, \Delta_2, \cdots, \Delta_i, \cdots\}$ in range of O-D. The strategy of connection plan contains two aspects:

- Parallel O-D route for evacuation

In direction of $\Delta_i(O, D)$, there is any public transit set $V = \{v_1, \cdots, v_i, \cdots v_n\}$ that relates to roads in the distance of λ with $\Delta \cap V \ne \phi$, which means common or parallel route in the area of O-D station with weight of ω_i. As more than one route appears, the weight set $\alpha = \{\alpha_1, \cdots, \alpha_i, \cdots, \alpha_n\}$ is defined, which is order by more overlap and longer routes. Then evacuation capability conveys $Q^V = \sum_{v \in V} q_i^V(v_i) \cdot \alpha_i$, aiming to reduce passenger load through the same or similar routes. If $\exists P_H \ge Q_H$

$$\max f' = \max Q_H^V / (P_H - Q_H) \quad (10)$$

- Vertical O-D route for nodal connection

On purpose of passengers leaving transfer station in the shortest time, coordination serves as primary approach to reduce accumulation effect of passengers. The field is attained through transfer hub ε_h, treated as center and the radius γ that includes routes set $Y=\{y_1,\cdots,y_i,\cdots y_n\}$. In order to accelerate passenger flow, objective function is

$$\max f''=\max\left(Q^Y \Big/ \sum_{t_0}^{t}\sum_{l_i\in L} P_H^D\right) \quad (11)$$

The algorithm takes transfer stations as node layer of URT network, multiple connection banding areas are formed on the basis of distance from near to far.

V. DSS OF SUPERVISION AND OPERATION

Considering requirement of information sharing and derivative information for emergency decision making, a hierarchical Supervision and Operation Decision Support Platform (SODSP) based on network operation is built, and supervision of trains or equipment, resource allocation optimization are included.

A. Structure of Multiple Hierarchical Platform

SODSP is designed for three layers of users, including stations, rail lines, and network center. Firstly, entire supervision information comes from this layer, which is collected into data exchange center, then disposed information is converted into network center to produce operation decision schema, by applying algorithms before mentioned.

Business of URT network operation is set up as corresponding function modules with actual workflow. In specific, information collection module contains monitor alarms, trains status, and statistics, and network operation module includes evaluation, passenger analysis, and pre-alarm evacuation. The core module covers accident treatment process that involves duty tasks, rescue resource collocation, emergency command, treatment evaluation, and drill training. Moreover, fundamental modules of GIS application and message dissemination are used to common components for map and notification tools.

All of data derived from Integrated Supervisory and Control System (ISCS) can be collected and saved in database, which supplies resource for Information Sharing platform logically [12]. The platform provides all sorts of data disposal tools, including message queues, data access, XML data, custom APIs, data synchronization, GIS rest, etc. The frame of SODSP is as Figure3.

These processing data will be separated into two parts, one for online database, and the other for history database that links to virtual tape library. Some of business data is abstracted to show the current state of URT network, just as trains or equipment operating mode. In order to accelerate query of application records, the strategies of retrieval like writing stored procedures and building index have been widely adopted.

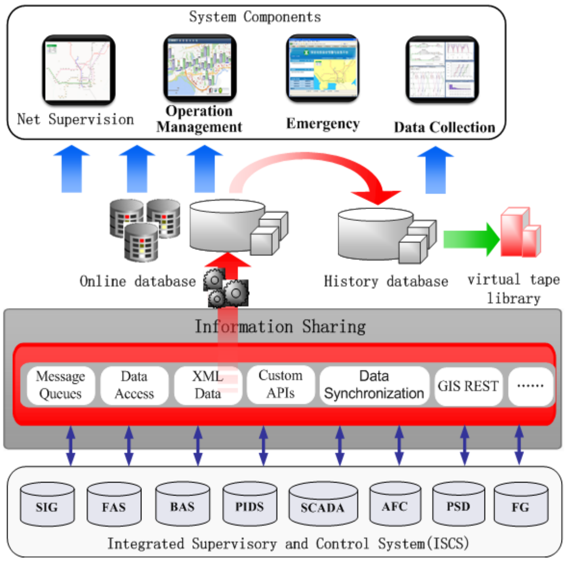

Figure3. Structure of SODSP

- Network and hardware.

SODSP adopts double net to attain reliability of transmission. Excellent servers of application and GIS in high available mode can insure superior flexibility and dependability.

- Data resource and processing.

Crucial data includes real-time data, history data, and transfer data from different systems, which is collected and disposed into united format in United Information Processing system (UIP) to meet for respective application in SODSP.

- Application service.

Common applications offer GIS map query, remote video meeting, CCTV, and information release. CCTV system screens video images of station hall or entrance to collect the scene in real time. Information release system provides notification and report while accident happened, and also acts as application service of daily forecast. As for special emergency application performs on normal procedures, relative independent node is extracted to sign different role, which allows cite or modify certain information and the nodes posses previous or succinct relations, to secure exactness of procedure continuity for respective users.

Static data will be collected from supervisory systems for decision making. It also supervises potential dangers and important protected facilities, e.g. flammable material, gasoline nearby stations. In addition to modules of supervision and operation management, there are special subsystems for information analysis are designed.

B. Information Sharing and Data Exchange

The crucial techniques of large information sharing in SODSP are employed to solve problems of real-time and standardization. Collection cycle of supervision information is set about 0.5 second based on data exchange protocol. Another approach of transmitting data, like applications, data files, object, depends on message queue technologies that acting as container to finish collecting, translating, and filter in order to shield difference between hardware, database, or communication format, etc. SODSP adopts combination of Client/Server and Browser/Server, just for respective subsystem and data exchange.

As large scale processing and higher throughput, UIP defines XML as standard format to exchange data to secure transmission reliability through introducing message queue that dispose information when moving data from orientation to destination. It supplies delivering, collecting, and routing for data in order to realize application integration. The prominent performance lies in obviating differences in hardware, database, message and communication protocol, which determines convenient and swift correspondence abilities between applications.

Due to security level of network that running supervision control system is often higher than other system like OA, we apply independent server to serve as front processor, which finish duty of collect resource data, provided by special supervision systems running in producing network.

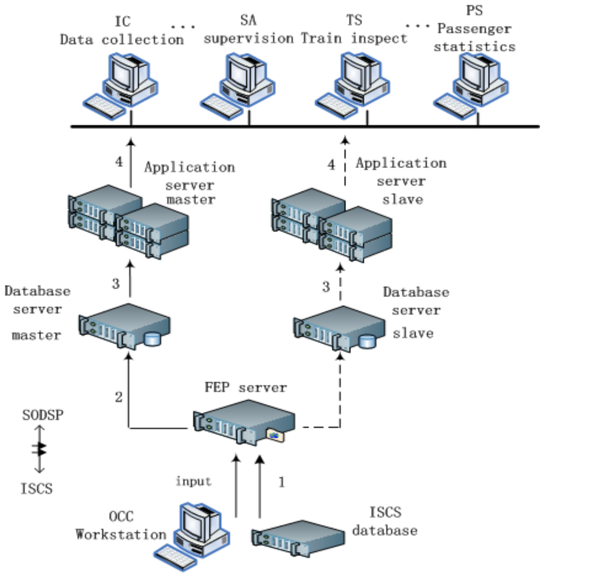

Figure4. Process of data disposal in supervision systems

In the process of data disposal in SODSP, there are four crucial steps in Figure 4 as follows: (1) information collection with cycling read from supervision systems; (2) Data disposal and analysis for saving in database server; (3) retrieval data of operation and equipment is transfer to application server; (4) According to alarm information, business subsystems analyze and evaluate for users correlated to respective rights.

VI. System Implemention

In our project, SODSP is applied to emergency center for certain city. The net for data transmission lies in private network channel, using dual-net redundancy, higher available clusters, multi-levels storage, and nested backup to attain security. The system also integrated several independent systems, such as message dissemination system, video meeting system and CCTV monitoring system, to supply data for decision support.

A case of passenger full accident in Civic Center station is picked up to simulate operation coordination of rail lines and other traffic tools. At first, the quantity of passenger P_H on unit of date in May, is accumulated in the range of week, the results can be shown as Figure 5.

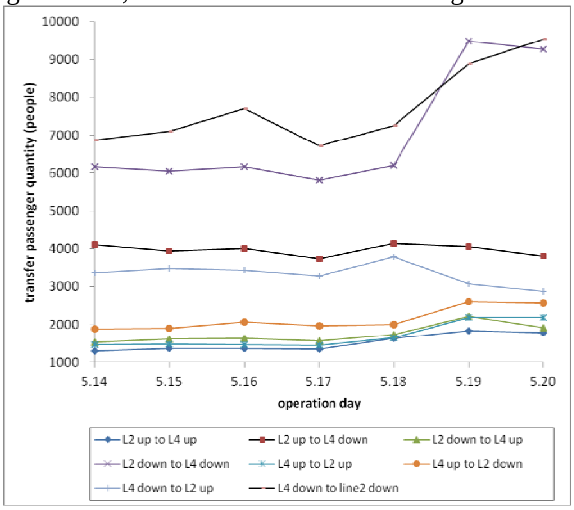

Figure5. Passenger accounted in SODSP

After analyzing passenger flow on the network, several transfer stations with gathering large amount of passengers will be found, including Civic Center station, which acts as main cooperated object in platform. Then linking time of trains for the transfer station is calculated to build coordination between the rail Line 2 and Line 4, and more often than not, part of trains could get to be coodinated. The transfer walking time of pedestrian is defined as average value, 5 minutes from Line2 to Line 4, and 4 minutes from Line 4 to Line 2. Focusing on passenger peak hours, interval of trains in Line 4 is 5′ 24″ , and 8′ in Line 2. Then algorithm mentioned before is employed to get time of the first cycle of trains and the result is shown as Table 1. So we can find Line 4 is easier to build transfer linkage to Line 2, otherwise the opposite, because of longer interval of Line 2.

TABLE I.
COORDINATION TIMETABLE IN PEAK HOURS

Wait time	Linkage direction	Reach Time in Civic Center Station			
		Line 2		Line 4	
second		Up	Down	Up	Down
146	4→2	×	8:12:38	8:05:12	×
207	4→2	×	8:12:38	×	8:05:11
271	4→2	8:14:39	×	8:05:12	8:10:35
99	4→2	×	8:21:38	×	8:15:59
22	2→4	×	8:12:38	8:17:00	×
235	2→4	×	8:04:38	8:10:36	8:10:35
164	2→4	8:14:39	×	×	8:21:23

SODSP collects supervision equipments from five rail lines with 130 stations. It collects equipment status from supervision system, e.g. PSCADA, BAS, FAS, ATS system. The four-grade alarm is designed according to extent of malfunction, with alarm report screened if it accepts alarm data. The amount of passenger is proportional pictured on rail lines of map based on data received from AFC system. Analysis of passenger flow is used to establish train plan and time tables according to coordination schema in transfer stations, and more important, passenger forecast can also be executed for correct directions of transport.

On the condition of crowed station, the commander sets out evacuation directions. SODSP is started through definite rescue process, in which emergency scheme and resource allocation are involved. Connection with other traffic tools with their routes relies on maps that can screen resource location and behavior records, which facilitates commander to master rescue resource layout and find out rescue program quickly, as Figure 6.

- Figure6. Rescue resource collocation in SODSP

SODSP shows usefulness of supervision and emergency prevention and its superiority in establishing rescue scheme in actual accident treatment since installed in URT emergency center. We have other problems like how to intelligently control equipment based on analysis results interacted with users and optimizing speed for further explore.

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