"NEW TRANSPORT ARRANGEMENTS USING ICT"

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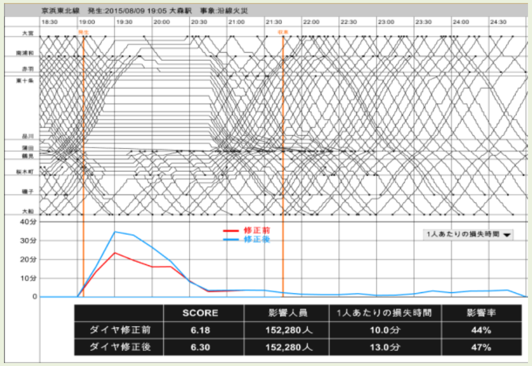
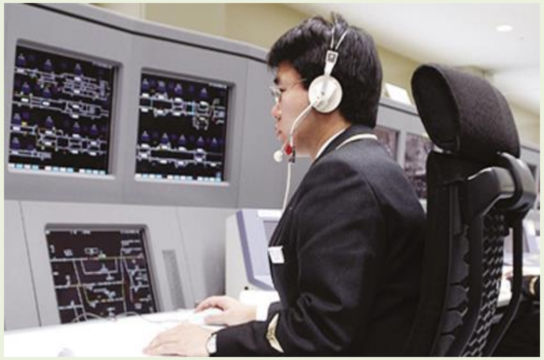
Introduction

Transport accident occurs



Dispatcher selects which train to cancel or adjust

Now decision based only on delay information and experience of past accidents



Developed a visualizing system for the dispatcher to quantitatively grasp congestion and delay of trains in real time and similar function for smartphone app to passengers.

Moreover, we studied methods to quantify congestion status of stations.

Introduction

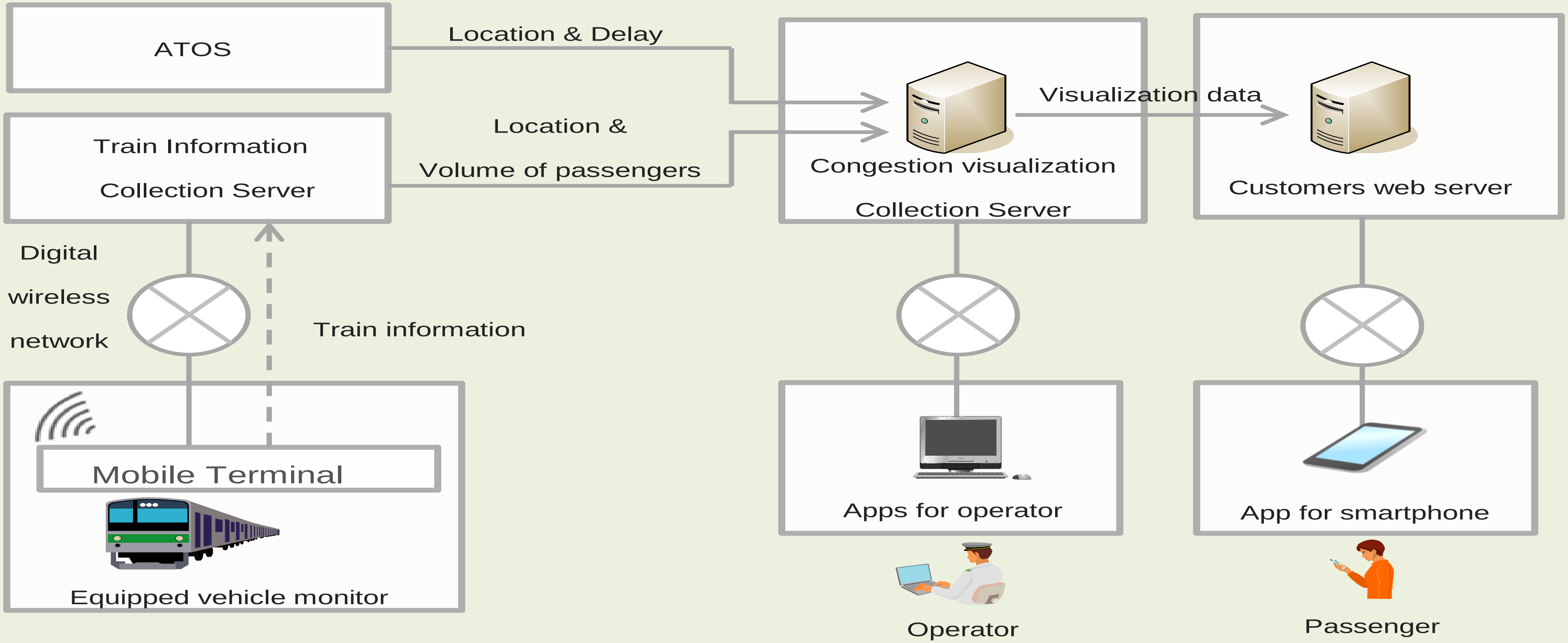
Advantage

What effect can we expect by visualizing congestion?

① Dispatcher can operate in accordance with the congestion of the train.
② Provide a congestion information to customers , so that they can select a less crowded train and alleviate congestion.

Alleviates congestion and prevents further train delays!

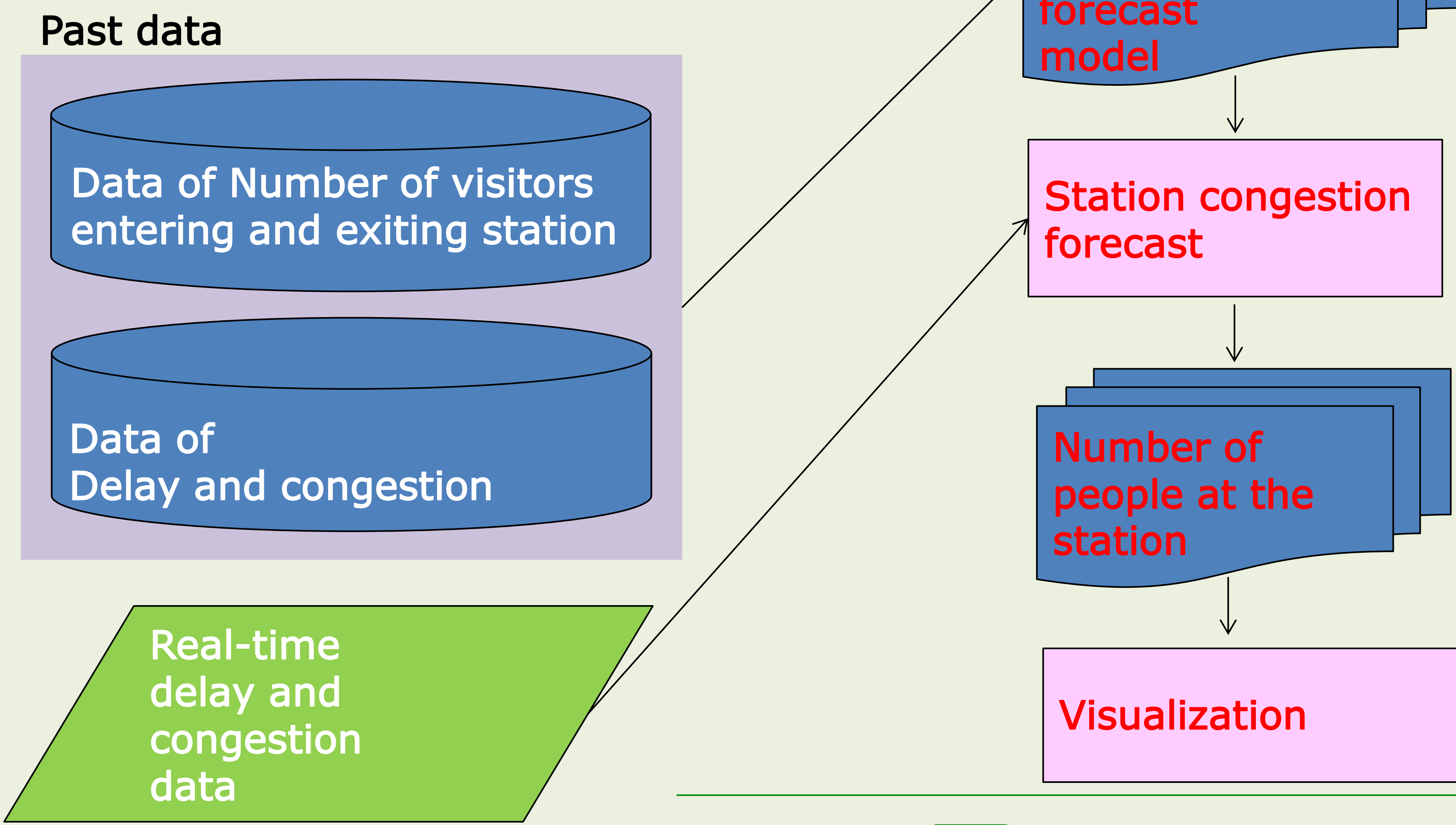
Data Process Flow



We use data on train location, delay time, and passenger volume in this study. This data is obtained from an existing system, namely a traffic control system (ATOS) and train data collection server.
Train has sensors which measure vehicle weight and by using this it is possible to calculate the approximate number of passengers riding on the train.

Forecast of Station Congestion

Flow of Station Congestion Forecasting



Forecast of Station Congestion

Data Process Flow

$$C = P_{enter} + P_{exit}$$

(C) ・・・ Congestion of the station area

It is sum of enter and exit number of visitors.

$$Y_{ti} = F(xj_{ti-1})$$

Made a station congestion prediction model by using the Random Forest, a machine learning method.

Objective variable

(Y) ・・・ Sum of entering and exiting people at the target station

(ti) ・・・ Time range

Explanatory variable

(xj) ・・・ Total value such as time of day, number of trains, number of passengers

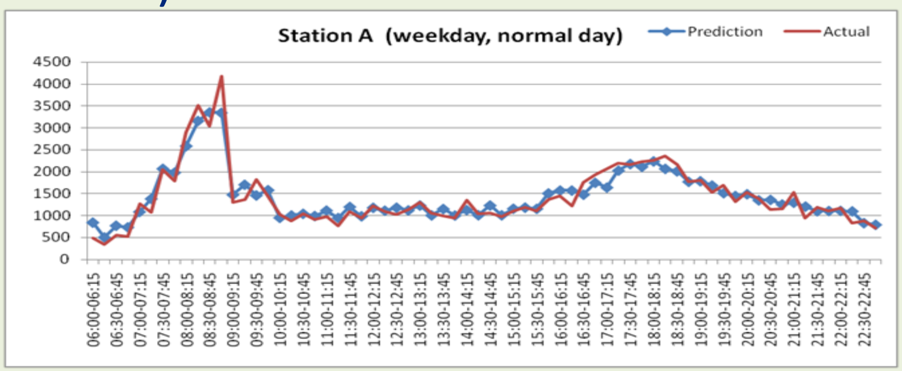
Estimate the station congestion (Y) of the next time range using the explanatory variables (xj) of the time range (ti-1).

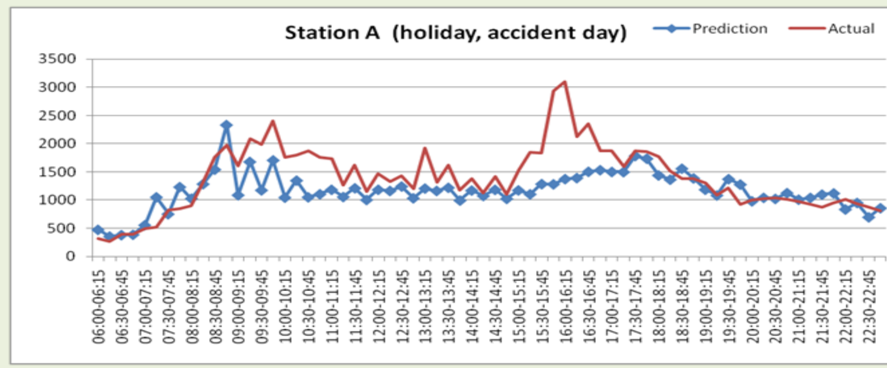
Station Congestion Prediction

Results of verification

①The forecast result of a typical day shows a trend similar to the actual value. (Mean absolute error rate: 12.6%)

②In particular holidays, the forecast results of a day in which an accident occurs deviates greatly from the actual value. (Mean absolute error rate: 20.7%).





This is due to the lack of learning data from holiday and accident days, which we need to address in the future.

Prototype System for Train Dispatchers

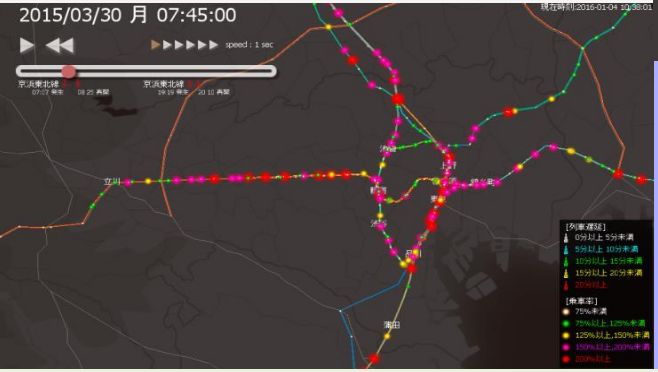
Concept of this system:

Show comprehensively the status of congestion both in trains and stations.

Functions :

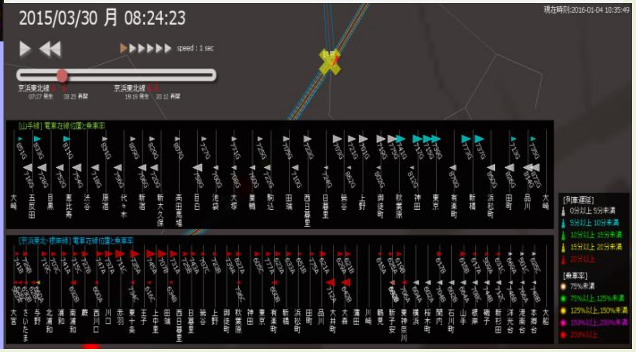
The prototype enables users to access both real-time data and historical data. In the past-display mode you can select the date and download the data you want to see and display it fast-forward.

Zoom-out Display
Focuses on crowded trains when displaying entire system.



Zoom-in Display
It is possible to confirm detailed information such as location and delay of each train.

Route Based Format
Displays several lines on the same screen.



Prototype System for Train Dispatchers

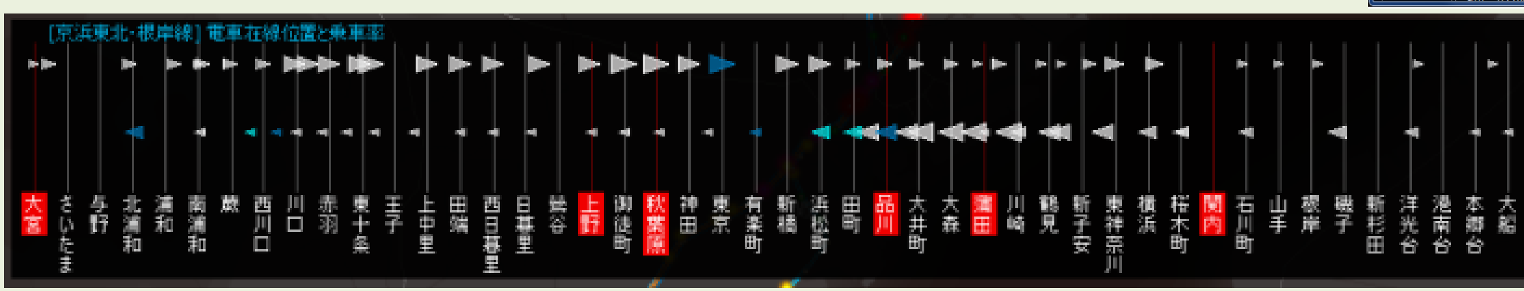
Station Congestion

① Displays the predicted value at units of 15 minutes from the current time up to 60 minutes away.

② Displays ratio threshold of resident number of people in the text.

③ Changes the size of ○ icons. Red color icon is greater than threshold value, green is less than threshold value.

④With "route unit view" stations exceeding threshold displayed in red.



※ Threshold of the station is the average value of the daily per-maximum number of people entering and exiting.

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Prototype System for Train Dispatchers

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From Oct.13 ,2015
Trial use in Tokyo Train Control Center

Prototype Smartphone App for Passengers

Display method

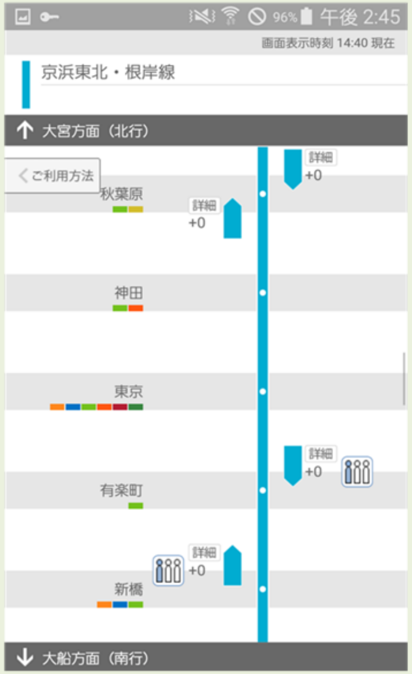
View congestion situation in the passenger icon.
Icon changes as congestion rate increases.

① Congestion rate <75%:
Displays blue single person icon
②75% ≦ Congestion rate <150%:
Displays orange two person icon
③ Congestion rate ≧ 150%:
Displays red three person icon

Train Congestion

Train Delay

Delay minutes

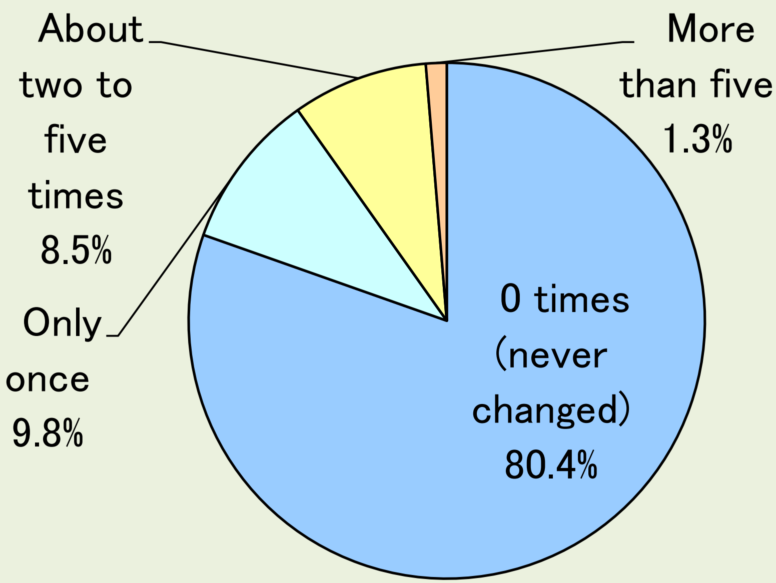


Dec 15,2015 ～Jan.19, 2016
Monitor survey of about 150 people

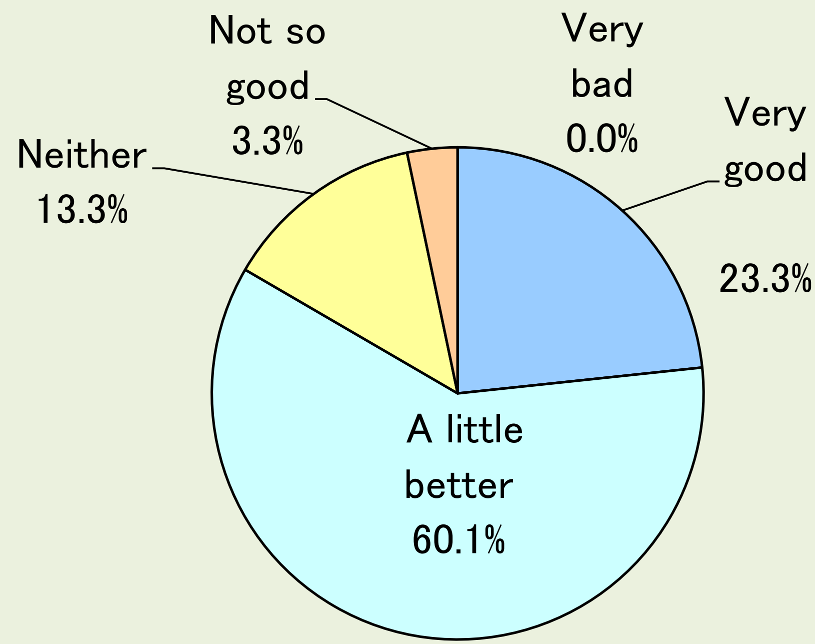
Prototype Smartphone App for Passengers

Survey result (Excerpt)

① Did you change trains after checking the congestion ?



② Was it good to change trains?



[Opinions from the monitor]

- Easier to find a seat after changing trains.
- It was comfortable to ride in uncrowded train.
- Knowing the delay, waited for next train which was uncrowded.

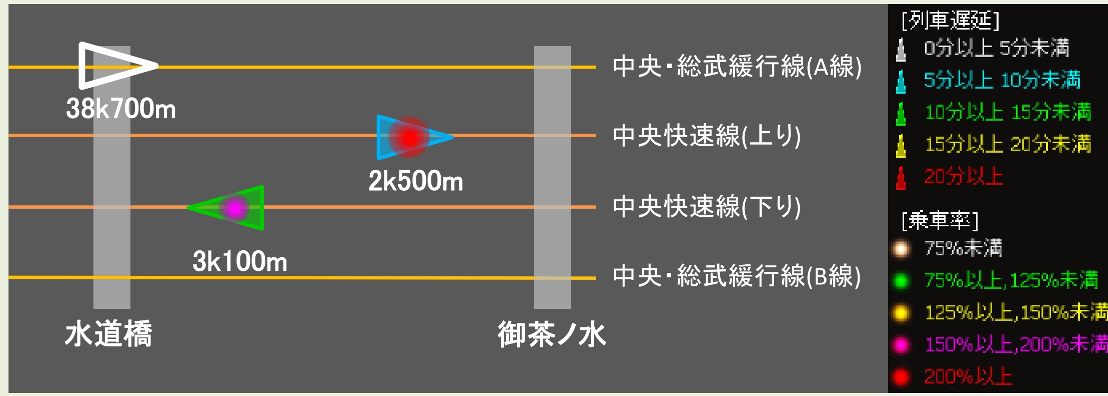
Most opinions were favorable !

For practical use

Expansion of function

Train congestion

Additional kilometer display

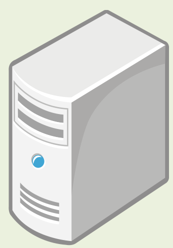


Station congestion

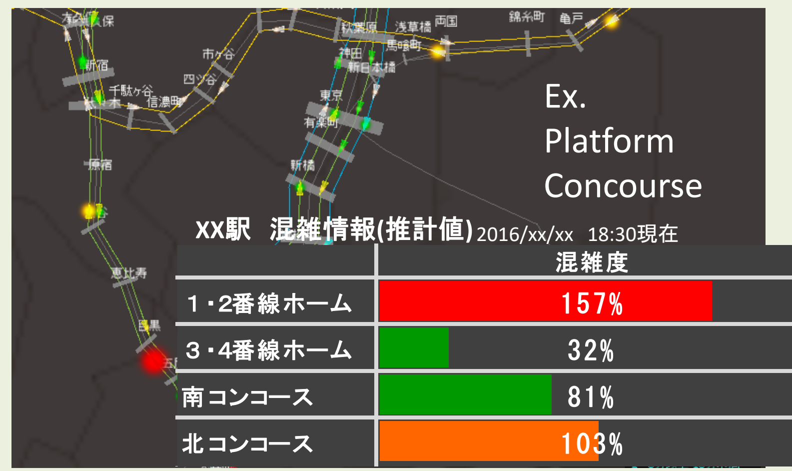
Forecasting each area in station

Existing data

- vehicle weight
- Location and delay
- Gate data



Analyze and simulate



Practical use this system in next spring !

Thank you for your attention