A Study of Park-and-Ride Systems in Provincial Cities

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Abstract— Provincial cities have limited public transportation services, such as public buses, light rail trains, and taxis. Therefore, many people cannot avoid using their passenger cars, which cause traffic jams at intersections, bridges, and tunnels. In many cases, park-and-ride systems have been introduced in these cities to alleviate these problems. However, even when park-and-ride systems are introduced, heavy traffic jams are still remained. In this paper, we focus on the park-and-ride system and discuss issues that cause heavy traffic jams. Then, we propose and discuss a new incentive-based park-and-ride system.

Keywords—park-and-ride; ITS; public transportation system; local city; traffic jam

I. INTRODUCTION

Many traffic jams in provincial cities are caused by commuting or sightseeing by cars. In many cases, a few bridges, tunnels, and other such structures have an important consequence as bottlenecks. Within provincial cities, there are also few railways, so that public transportation services consist of buses, taxis, and Light Rail Transit (LRT), whose schedule depends on traffic volume.

In order to decrease traffic volume, many cities are introducing park-and-ride (P&R) systems and road pricing, or toll, systems. Road pricing systems, in which drivers have to pay some fee at the entrance gate of a city, have been introduced in some cities such as London, Stockholm, and Milano. However, these are large cities that already have many public transportation services, such as subways or monorails.

In Japan, P&R Systems (as shown in Fig.1) have also been widely introduced (e.g., Sapporo, Kanazawa). However, many people do not use them. Fig. 2 shows the traffic volume of Kanazawa and Nonoichi cities through Google Maps. Many of these areas are prone to traffic jams.

In this paper, we consider the reasons why people are not using the existing P&R and propose a new P&R system.

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sparse so that customers have to wait at the station,

(3) If there are no trains, monorails, or subways, the
customer transportation schedule for buses and taxis
depends on traffic volume.

These are all reasonable concerns. However, based on
our observations, we suspect there are also other reasons, as
following:

(1) Destinations for more than half of the workers may
not be in the center of the city. Therefore, it is
difficult to use P&R systems,

(2) Many workers want to sit down while on public
transportation. Since these services are often
crowded, this can be difficult.

Therefore, P&R services have to solve all of these
problems.

III. RELATED WORKS

Some literature already exists to tackle these problems.
One of the most popular methods is to demand a bus system
[1][2]. Nakashima et al. [1] proposed demanding a bus
system for elderly and/or individuals who do not own a car.
Uehara et al. [2] proposed a P&R system that reduces trip
times. However, these ideas cannot solve all of the problems
outlined in the previous section.

The city of Kanazawa recently introduced a P&R system,
however, as shown in Tables I and II, there are too few
parking spaces, so most drivers choose not to use this
system. This city is prone to traffic jams, which are caused
by more than one hundred cars passing through particular
chokepoints in just a few minutes.

TABLE I  EXAMPLE OF TRAFFIC VOLUME IN
MORITO, KANAZAWA CITY

<table>
<thead>
<tr>
<th>Item</th>
<th>Daytime(12-hour)</th>
<th>Day (24-hour)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>49,063 vehicles</td>
<td>69,408 vehicles</td>
</tr>
<tr>
<td>Average speed (daytime normal)</td>
<td>24.3 km/h</td>
<td></td>
</tr>
<tr>
<td>Average speed (daytime crowded)</td>
<td>17.4 km/h</td>
<td></td>
</tr>
</tbody>
</table>

TABLE II  EXAMPLE OF PARKING SPACES FOR P&R
IN KANAZAWA CITY

<table>
<thead>
<tr>
<th>area</th>
<th>Number of spaces for vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chikaoka</td>
<td>5</td>
</tr>
<tr>
<td>Yanagibashi</td>
<td>56</td>
</tr>
<tr>
<td>Kan-nondo</td>
<td>58</td>
</tr>
<tr>
<td>Kitamachi</td>
<td>5</td>
</tr>
<tr>
<td>Magiramachi</td>
<td>5</td>
</tr>
<tr>
<td>Wakamatsu</td>
<td>20</td>
</tr>
<tr>
<td>Izumigaoka</td>
<td>30</td>
</tr>
<tr>
<td>Okuwa</td>
<td>50</td>
</tr>
</tbody>
</table>

IV. PROPOSED P&D SYSTEM

We proposed a new public transportation system using
buses. In Kanazawa and Nonoichi, there are many shopping
malls with large parking lots that could hold nearly a
thousand vehicles. Public transportation services might use
these spaces for parking. However, there are some problems
with this proposal:

(1) The merit of the shopping malls,

(2) There is no bus stop near some of these shopping
malls,

(3) There is no bus stop near many offices.

To solve these problems, we propose the following system:

(1) Commuters who park at the shopping malls should
be given coupons for the mall’s stores, so they can
buy discounted foods or products by coupon. This
system is one of the shopping mall’s merits, and
will help reducing overall costs for P&R passengers,

(2) The bus routes and stops for the P&R system should
be reviewed. There need to be bus stops within a
five-minutes’ walk of all shopping malls that will
serve as parking lots for P&R. There should also be
bus stops near half the number of all offices. For
this review, the simulation should show the actual
effect,

(3) The Minister of Land, Infrastructure, Transport, and
Tourism (MLIT) should observe and evaluate traffic
volume every year. The movement of people (not
just vehicles) should be observed by cellular phone
carriers or other organizations, and evaluated every
year as well,

(4) Every office should be accessible from a bus stop,
on foot, or by bicycle within five minutes.

V. DISCUSSION

With this plan, we think we can simulate traffic patterns
and routes exactly. In the future, we will be able to access a
person’s trip information as open data. Not all shopping
malls will need to supply parking spaces. It is difficult to get
the best solution for problems of movement through static
analysis. Through exact, annual simulations, we believe we
can get the best and most precise solution.

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