Traffic Prediction and Quality Evaluation for Improving Communication Quality during Major Events

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Abstract

NTT Network Technology Laboratories is studying event-traffic prediction and quality evaluation for preventing deterioration in communication quality due to a sudden increase in traffic during major events. In this study, we model user movement and communication behavior and predict traffic volumes and communication quality on the day of an event by prior simulation.

Keywords: traffic prediction, multi agent simulation, communication behavior

1. Countermeasures to traffic during major events

Recent years have seen explosive growth in the use of mobile terminals such as smartphones and tablets and the emergence of diverse media services. As a result, the communication applications for mobile users have become increasingly diverse, and data-intensive communications as in video viewing and image sharing on social networking services have become an everyday activity. This means that major events such as fireworks displays and festivals—that is, events where more than ten times the usual number of people can come together at a specific time within a specific space—can potentially generate large volumes of mobile traffic that existing facilities and resources cannot easily accommodate. Consequently, the problem arises as to how to estimate the communication resources needed and implement appropriate countermeasures such as adding more facilities and resources in order to carry such a large volume of traffic and prevent deterioration in communication quality.

In general, past traffic data and actions implemented by operators can be stored for events that are held regularly, and such knowledge can be used when necessary to mount countermeasures to heavy traffic. With this approach, however, it must be kept in mind that the timetable and venue can change even for the same event, resulting in temporal and spatial changes in traffic. In addition, first-time events have no past traffic data, which makes accurate estimation of traffic volumes difficult.

2. Event-traffic prediction

NTT Network Technology Laboratories has proposed a method for predicting event traffic in the area surrounding the event venue by using simulation that inputs behavior rules of mobile terminal users based on two key assumptions: (a) the behavior of people at an event can be consolidated into typical behavior according to event content, and (b) typical user behavior for even a new event is equivalent to that of a similar past event (**Fig. 1**). With the proposed method, parameters such as map data and number of users are input into the user behavior model (behavior rules), and traffic volumes generated by simulation in certain temporal and spatial granularities are output. Here, the user behavior model consists of (1) a

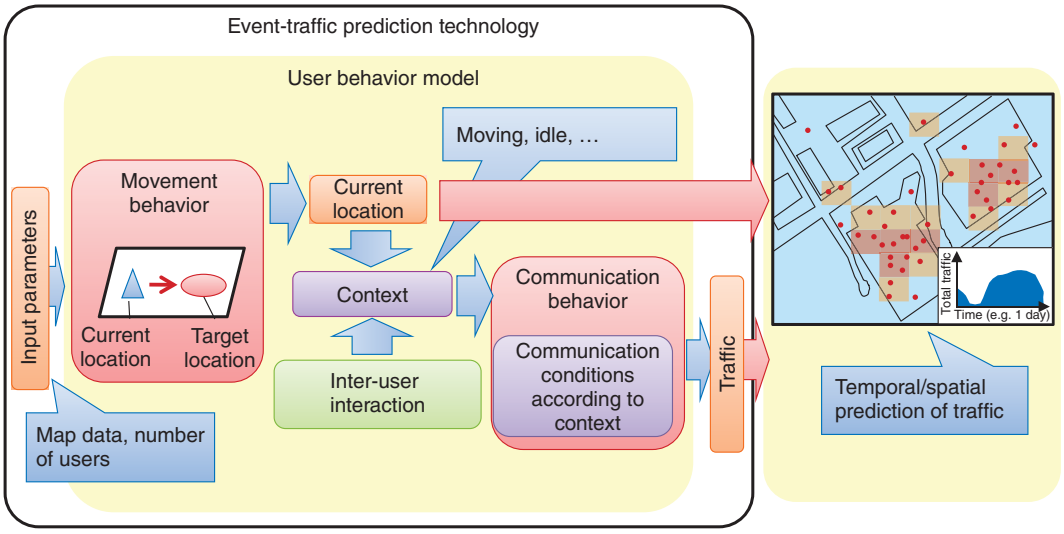

Fig. 1. Event-traffic prediction method.

movement behavior model describing user movement, and (2) a communication behavior model describing communication behavior, as summarized below:

(1) The movement behavior model consists of spatial movement rules in an event venue space. It determines a user's destination and route of movement within the time period simulated.

(2) The communication behavior model consists of traffic generation rules of a mobile terminal carried by a user. It determines the presence/absence of traffic and the traffic volume depending on the time, place, and surrounding area.

In this study, we consider that user communication behavior has a strong dependence on user context, and we model this feature accordingly. For example, we expect a user to communicate infrequently while in motion and frequently while waiting in line.

3. Event-time communication-quality evaluation

To accurately estimate the communication resources needed at the time of an event, we need to estimate the communication quality for the predicted flow of event traffic and specify the locations and times corresponding to a drop in communication quality. Techniques for estimating the quality of mobile communications have been proposed in the past. These techniques are used to estimate communication quality at any measurement point based on radio parameters such as interference and terminal receive strength. However, since many people can be expected to assemble at the same time during an event, resulting in communication conditions that are vastly different from normal times, estimating radio parameters for an event day beforehand has been difficult. This, in turn, has made it difficult to estimate communication quality.

In this study, we are focusing on the fact that the results of user behavior will affect radio parameters on event day and therefore estimate communication quality at event time accordingly. Specifically, based on traffic prediction results and a communication resource deployment plan envisioned for an event, we estimate communication quality on event day by inputting venue congestion and traffic flowing through each resource—which relate to radio receive strength and interference—into a mathematical model (**Fig. 2**).

4. Toward further improvements in communication quality

In this article, we introduced a study on methods of event traffic prediction and communication quality evaluation for dealing with sudden jumps in traffic associated with major events. These methods involve conducting prior simulations to predict mobile-user behavior that affects mobile traffic on event day and to estimate communication quality at event time.

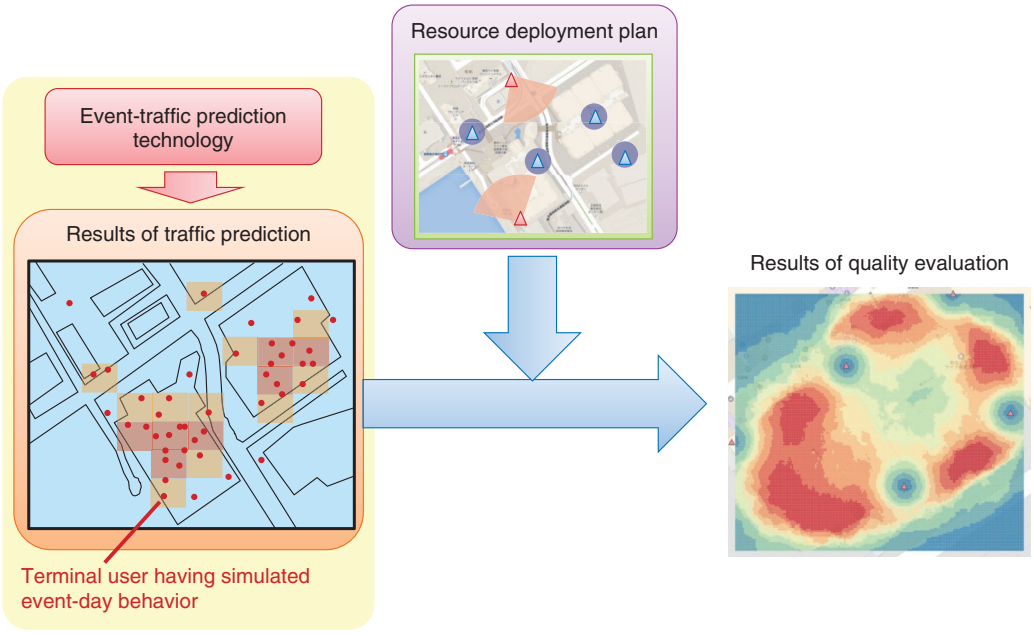

Fig. 2. Overview of quality evaluation technique based on event traffic.

These methods can be applied to facility design, as in deriving optimal locations for deploying communication resources. In the future, we expect that these methods will be applied in estimating and improving communication quality during the international sports event happening in Tokyo in 2020 and during other major events held throughout Japan.

However, from the viewpoint of monitoring and control, it is necessary to deal with changes in mobile-user behavior due to scheduling delays on event day and the holding of special events. Given the possibility of real-time and detailed network control by 5G (fifth-generation mobile communications systems) in the future, we plan to study the application of this technology to real-time control based on observed traffic and communication quality data in addition to prior facility design as described in this article.

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