Service Oriented Communication Technology for Achieving Assurance

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Abstract

The advancement of mobile telecommunication has made mobile commerce possible. It has been increasing even more that the requirement for mobile commerce to provide not only location aware but also timely services for daily life, which cannot be satisfied through the global information services such as e-business on the Internet. !! In the retail business under the evolving market, the users would like to utilize convenient services provided by the retailers within accessible area certainly. The retailers need to grasp the current requirements of the majority of the users in their own vicinity trade-areas in order to determine the appropriate services, which are called the Local Majority based services. This service marketing information should be temporary because the users consisting of the Local Majority and their requirement constantly change. More over the available service has a time limit and the area should become narrower with the time.

Reliable communication between the retailers and the users is required for the provision of the services. Real-time property is also required for the marketing of the users' requirements and the provision of the Local Majority based services. Achieving assurance for these requirements under the evolving situation is required.

Time Distance, which changes with the situation such as the congestion of the street, is introduced as the efficient measure of the distance between the users and the retailers. The Time Distance Oriented Service System has been defined to satisfy real-time property and reliable communication in the local trade area, where the users and the retailers have cooperative roles both for the provision and utilization of the services under the evolving situations. The system architecture, and the autonomous interactive communication between the users and the retailers are presented. Here, nodes have autonomy for fading unnecessary and inconvenient information through time distance based communication among them both for the marketing and provision. The nodes also autonomously reduce the information service area for achieving further effectiveness.

It is shown that this architecture and technologies realize assurance for the real-time properties and reliability and achieve effectiveness in mobile commerce.

Key Word *Community, Local Majority, Autonomy, Information Service*

1. Introduction

Due to the advancement of mobile telecommunication and wireless communication technology, users can access information services with a mobile terminal anytime, anywhere. In Japan, more than 42 million people access the Internet with mobile phones such as I-mode. The circumstances surrounding mobile users are constantly changing realistically, and their requirements are also changing with the situation. Users require the utilization of unknown but appropriate services at a precise moment. Thus, service providers need real-time comprehension of users' requirements.

In conventional global information services on the Internet, providers assume users have direct access to each provider's site and users have to search for providers individually. Therefore, users cannot timely utilize appropriate services, and service providers cannot achieve real-time service provision.

Systems using a service accelerator (SEA) system and an autonomous decentralized service system (ADSS) to provide personal services have been reported[2, 3]. These systems mediate between service providers and users and provide individual users with services based on their profiles. Conventional location awareness systems using mobile terminal can provide services based on the users location[4, 5, 6]. These papers describe a basic concept of service mediation platform, but they assumed that each service is provided to static area and real-time and local majority requirements cannot be satisfied.

Here, the Time Distance Oriented Service System is proposed to meet the requirements for the local but familiar in daily life information services. For realization of the community service system, real-time and reliable service utilization and provision techniques are clarified, where users, service providers and nodes have autonomy for communication and processing. This paper first clarifies the requirements for obtaining local but familiar information services. Then, it describes system architecture and autonomous interactive communication techniques.

2. Requirements

In this section, one of the typical applications of the local but familiar services is demonstrated, and system requirements are clarified.

2.1. Application Requirements

Here, a typical information service is shown. It achieves not only local and daily information services but also real-time service utilization and provision by members' interaction. It consists of real-time marketing and time sale announcements. Service providers carry out real-time collection of users' requirements first and determine products for the time sale. Then, the time sale information is broadcasted to users.

Real-time marketing

Each service provider wants to carry out marketing in real-time and accumulate users' requirements exactly to provide the most suitable service for users on the spot. Each user's requirements differ from person to person and the length to go for each requirement is based on individual preference such as purchase frequency, price and so forth. Users tend to buy daily necessities near their houses. On the other hand, they tend to buy expensive products at a department store that is situated far from their houses. Figure 1 shows a user preference. He wants some bread, a teacup and a PC. He would buy each product at the bakery nearby, at the super market down the road and at the electronics store on the other side of town, respectively. Each request should be sent to the appropriate service providers according to the users preference and their location.

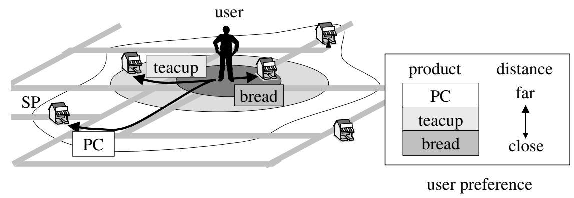

Figure 1. User preference

Time sale announcement

When service providers collect users' requirements in real-time and determine product discounts, this service should be temporary and have a time limit because users are constantly on the move and the result of real-time marketing changes dynamically. Therefore, time sale of the products is carried out. When time sales are provided, this information should be provided to the areas available to achieve efficiency in real-time advertising.

Figure 2 shows that the area is becoming narrower as time goes by. So, whether the users can utilize the sale or not depends on the time distance. In order to provide information only to the consumers who can get there in time, the information distribution area changes with the time.

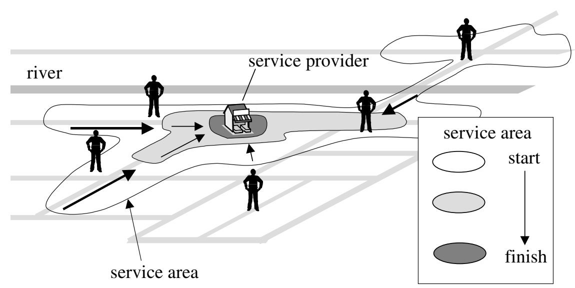

Figure 2. Time-limited service

In this application, users and service providers require the utilization and provision of location and situation awareness information for appropriate services. They also require real-time interactive communication with unspecified users or service providers according to their location.

2.2. System Requirements

The system that generates the service according to the situation on each occasion by collecting demands of users on real time in local area and provides suitable users with information like this application is asked for the following requirements.

Real-time property

To achieve appropriate services on the occasion, users and service providers require the utilization and provision of location and situation awareness information. Each request and service information distribution area should change dynamically according to each location, time distance, contents and so forth. Therefore, real-time properties to the dynamic situation are required for the system.

Reliability

Service providers are required to accumulate users' requirements in real-time, and they require distribution of the service information to the users in the service area available, which becomes narrower as time passes by. However, service providers cannot specify the users to communicate with in advance because they are constantly on the move. Users also require their requests to be sent to the appropriate service providers according to their preference and time distance, and they require the utilization of suitable information. However, users cannot specify the service providers to communicate with in advance because the service providers generate services after real-time marketing. Users also don't know which service provider can satisfy their demands.

Therefore, reliability for realizing communication in the local area is required of the system.

Thus, the system is demanded to achieve assurance of real-time properties and reliability under the evolving situation.

3 Time Distance Oriented Service System

Time Distance Oriented Service System is proposed in order to satisfy system requirements described previously.

3.1 System Architecture

Figure 3 shows the system architecture. The system consists of the nodes such as a base station of the mobile network, which are connected by the network and can transmit data among physically neighboring nodes, and the users and the service providers in the cell correspond to the nodes. The links among nodes and between the node and the provider have a static connection because their position is fixed. Nodes can broadcast messages to the users within the sphere of the cell, and the users have a wireless connection to the neighboring node. Each node has a time distance

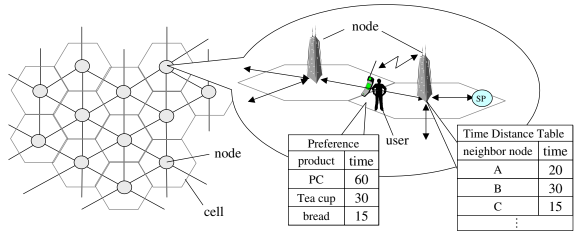

Figure 3. System Architecture

table, in which time distances from neighboring nodes are registered. !!

4 Autonomous Interactive Communication Techniques

!!In this section, time distance oriented information distribution techniques are proposed to achieve real-time properties and reliability within the local area.

4.1 Time Distance Measuring Technique

!!In the Time Distance Oriented Service System, the nodes distribute each message according to time distance between the nodes. Here time distance measuring technique is presented, which is realized by autonomous background processing of nodes and user's mobile terminal.

Figure 4 shows the sequence of the time distance measuring. Each node sends its ID to users in its own cell. The user's mobile terminal records the ID and received time. The mobile terminal can detect movement from a node to another by comparing the IDs. If the mobile terminal receives ID from node A at time T and node B at time T, the time distance T between node A and node B can be calculated by the formula (1).

$$T = T \quad T \qquad (1)$$

The mobile terminal sends T to the node B as the time distance from A based on the message format. Node B records T in the time distance table. Thus each node can measure the time distance from neighboring nodes by the users' migration.

If every user in the cell sends the time distance information to the node at each movement between cells, network

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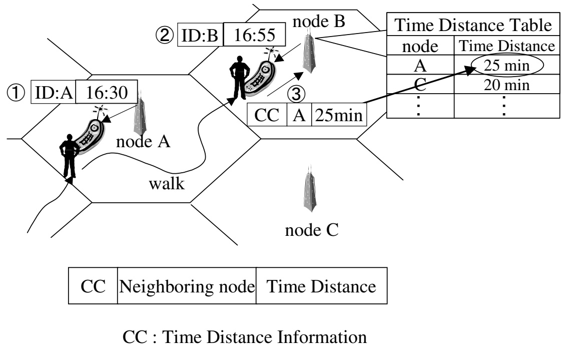

Figure 4. Time Distance Measuring

congestion might occur, and some mechanism to avoid congestion is necessary. For example, nodes select some mobile terminal in the cell randomly at regular time intervals, and avarage each time distance. However the traffic depends on the width of the cell. If the cell is small, users move across cells frequently. On the other hand, if the cell is large, users migration seldom occurs.

4.2 Autonomous Information Fading Technique

Autonomous information fading technique is proposed to the realization of the real-time marketing. The user sends the request with the time distance based preference to the neighboring nodes. This preference shows the user would utilize the service if it were possible to get there within the time distance AT. The request messages contain the cumulative time distance CT. At each node, the node adds the time distance from former node and the cumulative time distance CT. CT_n of the time distance at the Nth node is expressed with the following formulas (2).

$$CT_n = \sum_{k \ 2}^{n} T_{k \quad k-1} \quad (n \geq 2) \qquad (2)$$

The node judges whether request is decreased there or not. If the cumulative time C is larger than the time distance T of the request, the node disposes of it. Nodes comply with the following algorithm (3).

$$A \ ti \ n_{n \ de} = \begin{cases} N \ t \ in & \text{if } CT \leq AT \\ is \quad se & \text{if } CT > AT \end{cases} \qquad (3)$$

Thus User request information is faded according to the time distance, and service providers can accumulate the appropriate information based on the time distance (Figure 5).

As a result, Service providers can get real-time marketing information.

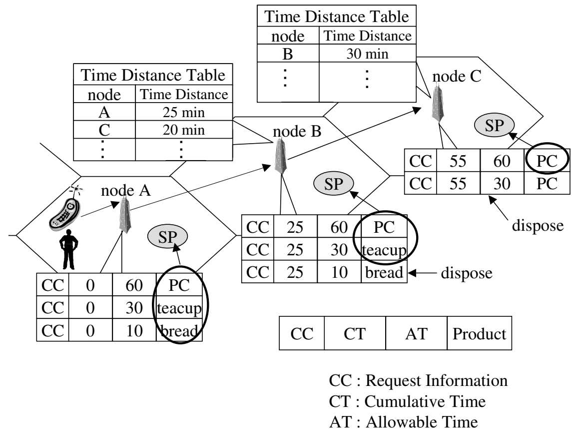

Figure 5. Real-time marketing

4.3 Autonomous Information Shrinking Technique

Autonomous information shrinking technique is proposed for distribution of the information, which includes time properties such as the time sale period. Such kinds of information should be distributed to the members in the area available, which become narrower as time passes by.

When a service provider announces the time sale information, the service information is distributed to the nodes based on the time distance. The service message contains the finish time of the service T and the cumulative time distance C. At each node, the node adds the time distance from former node and the cumulative time distance CT. CT_n at the Nth node is expressed with the same formulas(2). Then, nodes judge autonomously whether the announcement to users should be kept or stopped, in compliance with the following algorithm (4).

$$A \ ti \ n_{n \ de} = \begin{cases} kee & \text{if } CT \leq T_c \quad T \\ st & \text{if } CT > T_c \quad T \end{cases} \qquad (4)$$

As the result, service information is destributed only to the area available. Figure 6 shows the example of a time sale from 13:30 to 14:30. Node A, B and C broadcast to the users in their cell at 13:30. At 14:00, node C has stopped broadcasting because cumulateve time distance (=55) is larger than $T_c \quad T$ (=30). At 14:10, node B has stopped broadcasting because cumulateve time distance (=25) is larger than $T_c \quad T$ (=20). Thus service area available shrinks in real-time.

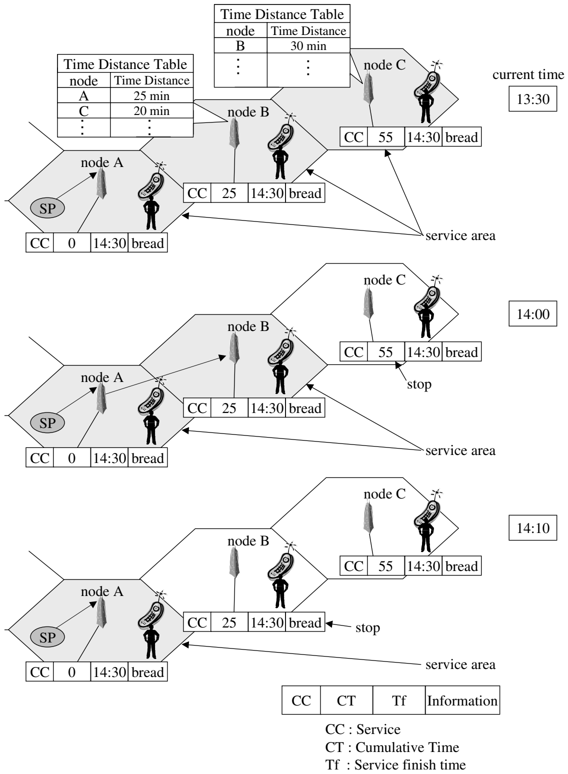

Figure 6. Informaiton Shrinking

4.4 Autonomous Cooperation Technique

Autonomous Cooperation Technique is proposed to achieve reliable communication.

Each node sends a signal to neighboring nodes at regular time intervals T. When a certain node is down, the signal is stopped. The neighboring nodes can detect the node's down by watching the signal. If the signal does not come even if it passes over the time T, the node is judged as a failure node. When the neighboring nodes of the failure node send the message, they attach the urgent header containing urgent flag, failure node ID and sender node ID to the normal message, and send to every neighboring node except the failure node. Nodes, which receive the urgent message, judge whether the message should be sent to the neighboring or disposed. If the failure node is the neighboring, the node sent every neighboring node unconditionally and checks the message history and judge whether the cumulative time can be restored. If the cumulative time is restored, the urgent header is removed and the message is sent as a normal message. If the failure node is not neighboring, the urgent message is disposed. Thus, information is surely distributed except failure nodes (Figure 7).

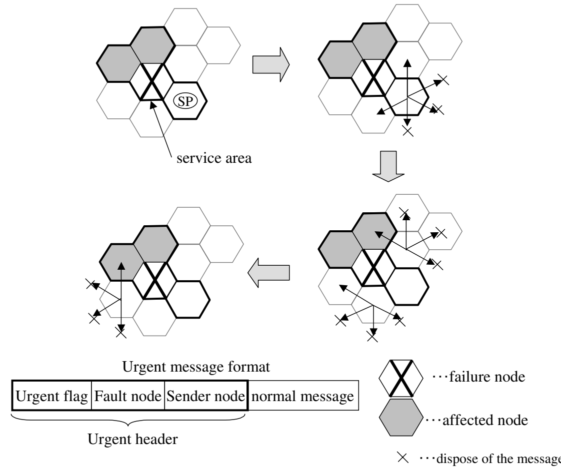

Figure 7. Autonomous Cooperation Technique

5 Conclusions

The requirements for obtaining local but familiar information services, which cannot be achieved by the Internet global information service system, have been clarified. Under the evolving market of the retail business, the users requirements of accessible and desirable services change dynamically, and the retailers have to accumulate the requirements of the Local Majority to provide the most preferable services.

Here, Time Distance is introduced as the effective measure for the marketing and provision of the services in mobile commerce. Time Distance Oriented Service System is proposed, where the users and the retailers have cooperative roles both for the marketing and provision of the services under the evolving situations. Each node has autonomy for not only interactive communication but also for information processing of the selection and fading to achieve real-time and reliable services in the local trade area.

It is shown that this architecture and technologies realize assurance for the real-time properties and reliability and achieve effectiveness in mobile commerce.

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