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Regional Activation based on P2P Network Architecture

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Abstract - In this paper, we propose the usage of a P2P network technology for realizing regional activation on regional communities. We describe the network structure about both the inside of regional communities and the connection among regional communities, and illustrate how regional communities could arouse their activities using the P2P network technology through the simulation result.

1. Introduction

A P2P network technology is advocated in 1998 as the brokerless theory.[1][2][3][4][5][6] So far the P2P networks have been implemented in various aspects on the internet. For example, file exchange services such as Gnutella and Napster, grid computing network (Flet's HIKARI Internet connection service of NTT) [7] and virtual currency control service (Bitcoin by Blockchain Technology.) [8]

We propose to apply the P2P network technology in regional communities because we think that several problems of regional communities are solved by using the P2P network technology.

2. Issues on Regional Communities

2.1. Regional Communities' Structure

Regional communities have been struggling to make achievements, e.g. a self-directive society, a self-sustaining economic growth and unique business opportunities. But it is difficult for them to lead always their efforts to positive results. We consider that the insufficient results depends on the regional communities' structures.

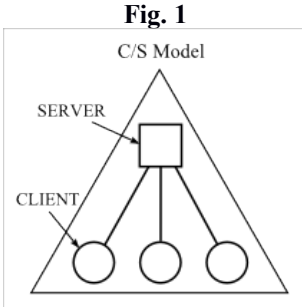
So far traditional methods of organizing regional communities are generally a top-down and centralized model, or a bottom-up and flat model. We define the former model as a Client and Server model (C/S model) and the latter one as a P2P pure model.

2.1.1. C/S model

As illustrated in Fig. 1, the C/S model provides communities for a hierarchy form structure. Organization builders, directors or operators take the role of servers and connect themselves to members as clients. The problems of this model are as follows:

- High cost
- Causes community's collapse when the server crashed.
- Causes stop or stagnation of community's activities because of the overflow or the delay of response time on the server when the number of clients increased.

Fig. 1

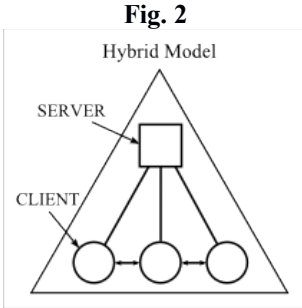


2.1.2. Hybrid model

As illustrated in Fig. 2, the hybrid model is composed by servers and clients as well as the C/S model. The difference between the hybrid model and C/S model is that a server on the hybrid model gives permission its clients to act in substitution for a server. It is used on some file transferring systems, e.g. Napster.

The hybrid model has a problem that the server gets overflowed when the requests from clients increased as well as C/S model.

Fig. 2



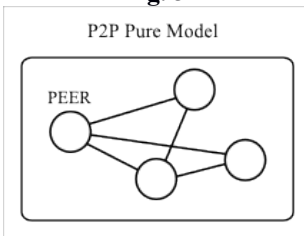
2.1.3. P2P pure model

As illustrated in Fig. 3, the P2P pure model is flexible because each client works as a connector, and has ability

to build a community characterized by low cost and high scalability.

But this model also has problems that it becomes difficult to manage and maintain clients' incentives to stay in the community because each client's incentive is different and various, and causes the community's lawlessness or collapse.

Fig. 3



2.2. Non Platform

So far a problem-solving method is a typical way to resolve regional challenges and create community businesses. We found that there are disadvantages to employ the problem-solving method for regional activation because we already recognized the same difficulty in developing software applications not executed on operating systems.

The problem-solving method project contains questions as follows:

- High cost
- Time-consuming
- Overlapping works
- Less quality improvement
- Difficult to share know-hows and collaborate with other projects.

Before we have operating systems, we needed to create a system from the beginning and that was expensive and time-consuming. A knowledge acquired through making a certain system was not able to adapt to other systems.

This problem is all applicable to regional activation. So we classified intersectional functions of the various and unique regional communities' activities and found that there are common functions among them such as promotion, funding, licensing, presentation and branding. We decided that we gather those common functions and put together to supply regional communities for a tool of regional activation.

From that point of view, the regional communities need to positively introduce the platform model to connect each other and share intersectional functions and make their activities more effective and less costly.

3. Proposing P2P network Model

We propose that the regional communities introduce a P2P network model which has characteristics such as the P2P semi-pure model, incentive-trust-connector and simultaneous participation in different communities.

3.1. P2P Semi-Pure Model

3.1.1. Structure of P2P Semi-Pure Model

Fig. 4

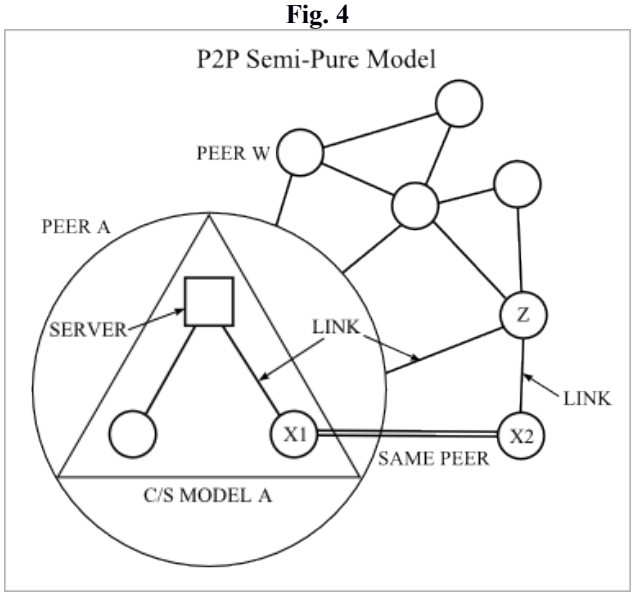


Fig. 4 illustrates the component of P2P semi-pure model as follows:

- C/S MODEL A functions as a C/S model.
- The Clients X1 is controlled on the inside of C/S model A.
- PEER A capsuling C/S MODEL A looks as a peer from the other peers (e.g. PEER W) existing on the outside of PEER A.
- X1 and X2 are identical.
- X2 functions as a peer and as a component of the P2P pure model on the outside of PEER A.
- LINK means that the peer situated at either end of the line (e.g. PEER X2 or PEER Z) knows the presence of each other.

As illustrated in Fig. 4, the P2P semi-pure model is a complexed type of the C/S model, the hybrid model and the P2P pure model. In the P2P semi-pure model, a server acts as a peer by being capsuled in a peer, and can participate in a P2P network.

In this case, the server has two faces. One is a face as a peer which can connect to other peers as well as the P2P pure model. The other is a face as a server connecting and controlling its clients as well as the C/S model.

In the latter case, a problem is that the clients capsuled together with its server in a peer will become inactive if the server crashed.

The P2P semi-pure model proposes a unique idea and solution to make the network structure more sustainable.

It allows the clients in the capsuled peer to come out of it and act as an independent peer.

In this instance, the client also has two faces. One is as a client connected and controlled by its server. And the other is as a peer which is able to connect with other peers using the P2P network technology.

And as another advantage is that the capsuled server works as a peer and can connect other virtualized servers to compose a massive server network like a grid computing network. When the different servers have connections and work together, synergy effects can be expected. For example, cross-industrial associations often produce innovative outputs.

The P2P semi-pure model also has a load distribution function since the servers and the clients work as peers.

We regard that P2P semi-pure model has advantages in cost and scalability in comparison to C/S model and Hybrid model, and is superior to P2P pure model in respect of sustainability and stability.

3.1.2. Simulation of Stability Performance on P2P semi-pure model and P2P Pure Model

As illustrated in Fig. 5, we developed a computer simulation program to measure and compare difference of performance between P2P semi-pure model and P2P pure model in forming virtual communities.

Fig. 5

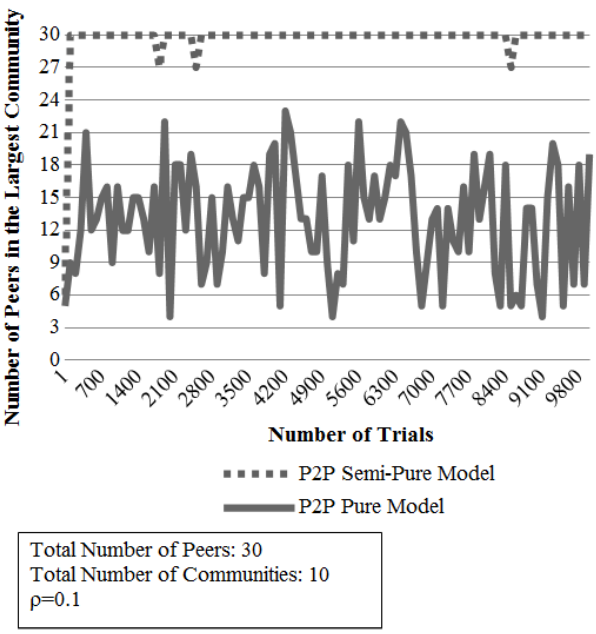


Fig. 5 illustrates the performance comparison of stability of the virtual communities between P2P semi-pure model and P2P pure model. The horizontal axis indicates the number of trials which each of the thirty peers tries a joining and a leaving action to each of ten virtual communities. The vertical axis indicates the number of peers in the largest community, i.e. a community which contains more peers than the others, after each peer's trial of joining and leaving.

In this experiment, we executed the trials ten thousand times and recorded the value every a hundred trials. A parameter "ρ" at the bottom left means the ratio ($\rho=\lambda/\mu$), i.e. the participation rate (λ) divided by the leave rate (μ.) From Fig. 2, P2P semi-pure model is superior to P2P pure model to maintain a stable community.[9]

3.2. Incentive - Trust - Connector

The P2P semi-pure model shows its capabilities such as low costs, high scalabilities and high sustainabilities. Regional communities introducing this model can obtain such merits as follows:

- Incentives of the community members are guaranteed to be fulfilled because the larger the community becomes, more various people, ideas and know-hows are accumulated in the community.
- Trusts of the community to other communities will rise up because the community's continued existence produces reliability..
- Connectors - The community's quality becomes better when the number of connectors is increased because the community composed by many peers acquires diversities and sustainabilities. As the result, such community attracts other communities and new participants.

3.3. Simultaneous Participation in Different Communities

Simultaneous participation in different communities, i. e. an action that one person belongs to multiple communities, makes those communities work or relate together. This is one of the important policies of the P2P semi-pure model. There are a lot of patterns to connect multiple communities by means of a few community members. It can make the community bigger. This is what to say, "A friend of a friend of a friend."

4 Introduction of the SCB Project

4.1. Proposing P2P Platform to regional communities

To make a regional community more effective we propose that the community has the form of the P2P platform by using the P2P semi-pure model.

In concrete terms, as morphing from a person, an activity and a facility to a peer respectively, they are connected with each other to build the P2P platform to host the community's activities. It is necessary to consider what types of peers are better combined for better activation of the community.

To materialize the P2P Platform for regional activation in the real world, we launched activities using the theory of Social Community Brand [10] at Sojo University SCB Broadcasting Satellite Studio (SCB Studio) in April of 2015.

Social Community Brand, advocated in 2011 by Takashige Hoshiai, is a new theory for regional activation to make communities using the Brokerless Theory such as P2P semi-pure model, simultaneous participation in different communities.

A demonstration experiment is currently in execution at the studio involving people, activities and facility as P2P peers.

4.2. SCB Studio

SCB Studio is established and located in the downtown of Kumamoto City, Japan. It has a broadcast facility on the first floor and "Activity Room" on the second floor.

There are lots of communities in active on the theme such as ICT, agriculture, business start-up, media, sports and voice acting, and the communities are run by the various human resources such as university students, IT engineers, public officers, medical doctors, designers, tour conductors and entrepreneurs.

4.3. Functions of SCB Studio

There are some co-working spaces, shared rented office spaces and rented conference rooms in the same area of SCB Studio. Compared to their service as only renting the space, SCB studio provides users for not only a space but also opportunities as follows:

- Constructing a platform composed of organic link among people, activities and facilities in brokerless, so to speak, it is "Brokerless Link among Regional Resources."
- Providing useful fundamental resources for the communities such as promotion, funding, licensing, presentation and branding.

The users of SCB Studio can build a platform by not a top-down and centralized model but the P2P semi-pure model with use of "Incentive - Trust - Connector" method and "Simultaneous Participation in Different Communities" method. On this platform, the communities are connected with each other and dissolve regional problems efficiently. In the future, the platforms are likely linked together if such platforms emerged anywhere over the world.

5. Conclusion

Regional communities (especially local communities) are suffered from a shortage of ideas, human resources, funds and social capitals due to uneven distribution of resources. Though it is a new trial to apply the theory of P2P network technology to regional community's activation, we would be truly happy if we see some sprouts of the community with use of the P2P network technology by whoever willingly makes an action for regional activation over the hedges of community, culture and country.

In closing, we would like to thank NOLTA2016 organizing committee members for their fruitful suggestions and comments.

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