

Peer-to-Peer Content Distribution Solution

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Abstract

Reliability, security and speed are sought as the foundation for the distribution of information in the ubiquitous society. This paper introduces content distribution using Peer-to-Peer connections. The system offers scalability and fault tolerance made possible through the adoption of the Peer-to-Peer connection, while also realizing reliability and assurance of security provided by the management function for copyright and verification of the content distribution status, which is essential for commercial content distribution, through the implementation of a management server.

Keywords

ubiquitous, broadband, Internet, Peer-to-Peer, content distribution

1. Introduction

Infrastructures with high reliability and security, along with services that can respond to a variety of needs are required by the ubiquitous society. For example, In order to realize large scale content distribution services, technologies and endeavors to ensure secure use of such service in a extensive environment is being sought. This paper introduces a content distribution solution, which uses the Peer-to-Peer system and resolves security issues that were of concern with Peer-to-Peer systems of the past.

2. Content Distribution Method

2.1 Representative Methods of Content Distribution

Information (content) being distributed in the ubiquitous environment is increasing in size day by day, while the number of users utilizing such information is also on the increase. Much information is digitized by businesses internally and being distributed to a large number of users at widely distributed locations, affiliated companies and stores. It is for this reason that the following is required to distribute content:

1) Efficient Distribution of Content

Distribution to numerous locations dispersed over an extensive area, must be efficient and require a short amount of time.

2) Management of Content

Mechanisms to protect the content and copyrights.

3) Facility Costs and Performance

Adequate facility costs and usability performance (load on networks and servers) for a content distributor, etc.

A number of methods have been implemented in order to respond to these requirements for content distributions (**Fig. 1**).

(1) Client-Server Method

This is a method that entails the acquisition of content from servers by numerous users.

(2) Peer-to-Peer Method

The Peer-to-Peer method entails the distribution of files and information directly between users (terminals) without going through a server.

The Client-Server method, which is currently the main method in use, experiences an increase in load as the number of users and frequency of access increases. In order to prevent problems arising from this, distribution servers need to be enhanced and the capacity of communication lines needs to be increased to larger amounts all the time, therefore, there is a tendency for costs to rise relating to facility investments after an operation starts. The content distribution using the Peer-to-Peer method is one of the methods that can be used to resolve

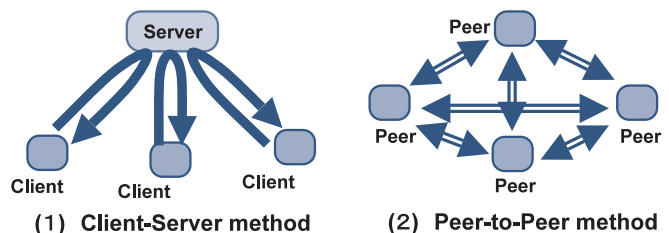


Fig. 1 Main methods used for content distribution.

such issues.

The distribution of content and further distributions from the distributed destinations is possible with the Peer-to-Peer method, which makes it possible to reduce the load on servers or to optimize transmissions.

2.2 Peer-to-Peer as a Content Distribution Method

File sharing in a typical Peer-to-Peer environment is realized when a terminal transmits a file stored on its storage device in response to a request from another terminal. The terminal that receives this file, transfers it to another terminal and this transfer is repeated (Fig. 2).

The content distribution method using Peer-to-Peer connections includes the following features:

(1) Scalability

Since the transmission of information is conducted between terminals with Peer-to-Peer connections, no particular terminal is burdened. Because the load can be distributed over the entire network with Peer-to-Peer connections, there is a high degree of scalability with regards to the number of terminals.

(2) Ad Hoc Attributes

The distribution method using the Peer-to-Peer connection allows for a freely changeable configuration of terminals for the distribution of content (ad hoc attributes).

(3) Fault Tolerance (Robustness)

Peer-to-Peer networks comprised of Peer-to-Peer terminals, do not have a single failure location that can cause the failure of the entire network if a malfunction occurs at a particular location.

On the other hand, the following issues exist with regards to

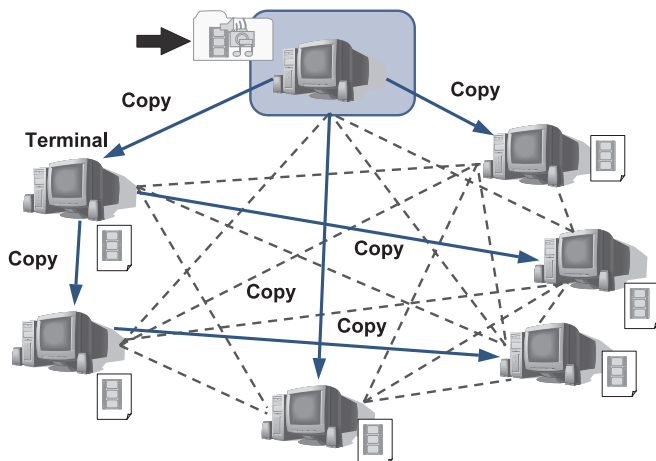


Fig. 2 Synopsis of Peer-to-Peer.

the distribution of content using a Peer-to-Peer network:

1) Verification of Content Distribution Status

It is necessary to keep track of how far or to which terminal the distribution of content has reached, the details of content in the care of individual terminals and the startup status of terminals, as well as to which terminals the content is routed through for distribution.

2) Protection of Content

It is necessary to ensure that distribution is not made to unauthorized terminals, unnecessary content is deleted and unauthorized copies cannot be referenced.

A description of the Peer-to-Peer distribution model that resolved these issues is provided below.

3. Peer-to-Peer Content Distribution System

3.1 Management and Protection of Peer-to-Peer Content

A description of a Peer-to-Peer content distribution system that uses the Peer-to-Peer content distribution method described in the previous section is provided here.

A Peer-to-Peer content distribution system is comprised of terminals that are installed with Peer-to-Peer connection capabilities, the “master peer” to which the file is placed first and a “management server”, which manages these terminals (Fig. 3).

The management server instructs a peer to acquire content, entrusting the determination of the source for actual acquisition of the content to the decisions made by that peer. Each

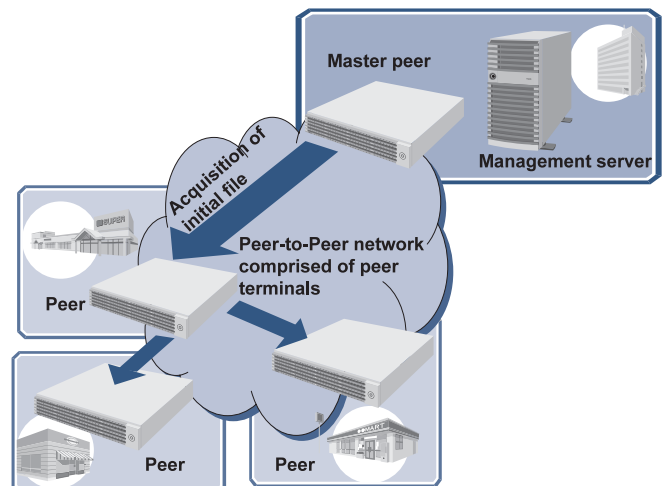


Fig. 3 Conceptual diagram of Peer-to-Peer content distribution system.

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terminal or server functions independently in such a functional configuration and through this, the balancing of features of the Peer-to-Peer connections with the management of peers and content, as well as protection of content, are realized.

(1) Management Server Functions

In order to prevent an outflow of content and to prevent unauthorized access to peers, which are issues of concern with Peer-to-Peer connections, the management server incorporates the following functions:

Status management of peers, detection of unauthorized peers, status of content in the possession of peers (download started, completed, etc.), instructions relating to content (acquisition or deletion instructions, etc.), copyright management, etc.

(2) Functions of Master Peer

The master peer is the peer that registers the content for distribution through the Peer-to-Peer network. Registration of content is conducted only through this master peer. The master peer is treated as an ordinary peer by other peers in the possession of the same level of functions as other peers.

(3) Functions of Peers

Peers function as terminals with autonomy. Peers take part in the management of content and peers by participating and performing management tasks in the Peer-to-Peer network, as well as acquiring and deleting content according to instructions from the management server and reporting the results of such action to the management server.

With the aforementioned configuration, it is possible to keep track of the terminal status and content distribution status at the management server, thereby resolving issues mentioned in Section 2.2-1). Furthermore, we are currently considering the issue of content protection mentioned in Section 2.2-2), through the preparation of contents with considerations for security, encryption of communication routes, authentication and grouping of peers^{1,2)}.

3.2 Increasing Efficiency of Content Distribution

The time required to distribute content to all terminals is shortened dramatically with the use of the Peer-to-Peer network. This is because when the distribution of content by one terminal is completed, that terminal is then able to distribute content to other terminals, thereby increasing the number of terminals that are in possession of the content and those receiving them in a geometrical progression. Furthermore, there is no increase to the load on the server since distributions are carried out between the terminals (Fig. 4).

When two terminals are designated as content distribution destinations to receive content simultaneously

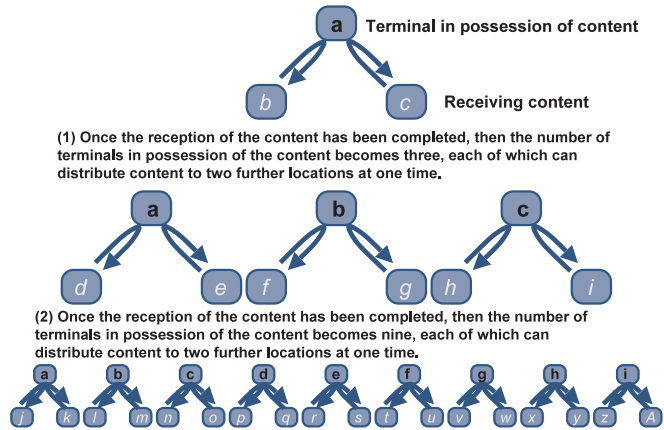


Fig. 4 Features of Peer-to-Peer content distribution.

4. Solutions Using Peer-to-Peer Content Distribution

4.1 Examples of Solutions Using Peer-to-Peer Content Distribution

Distribution of business operation data, as well as internal training content to related organizations and branch offices situated at many locations, which are dispersed over an ex-

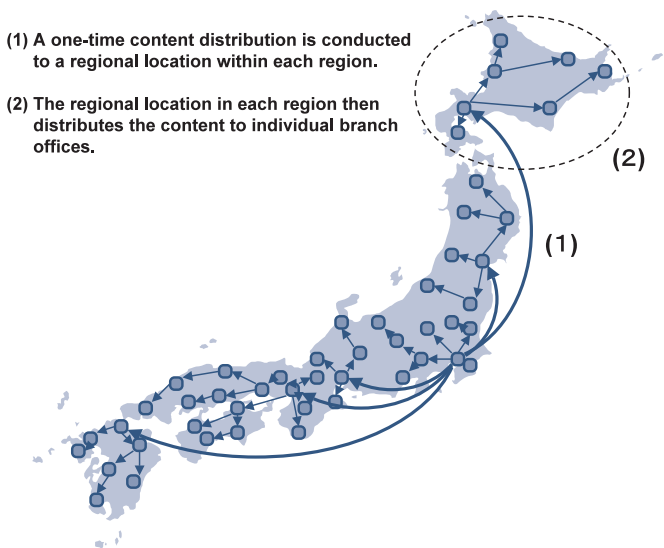


Fig. 5 Distribution of content to related organizations and branch offices situated at many locations dispersed over an extended area.

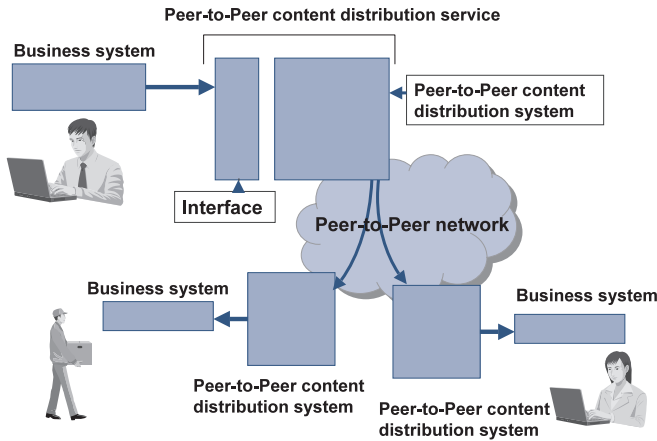


Fig. 6 Collaboration with business system for Peer-to-Peer content distribution.

tended area, can be mentioned as a solution that uses the Peer-to-Peer content distribution method (Fig. 5). Distribution of advertisements at convenience stores is also an example. Also, applications for the distribution of traffic information between in-vehicle devices using the Peer-to-Peer content distribution can also be considered.

Furthermore, systems that function in collaboration with business systems are anticipated for the content distribution in businesses (Fig. 6).

Instead of using a Client-Server method for sharing content in a business system, it is possible to share and distribute the content in an efficient manner by utilizing the Peer-to-Peer content distribution.

4.2 Content Distribution System for Convenience Stores

We exhibited at iEXPO2005, a demonstration system with a content distribution system for convenience stores described in the previous section.

We proved that advertisement material can be distributed from convenience store headquarters to individual stores, avoiding network problems at locations, which is an issue for systems in convenience stores, assuring the reliable distribution of content (Fig. 7).

5. Conclusion

Abstract of the Peer-to-Peer content distribution system and examples of solutions were introduced in this paper.

We will be making our contribution to the ubiquitous society by adding features with security levels that are selectable to be



Fig. 7 A screen representing a management server display shows locations of failure on the network.

consistent with service levels and by developing solutions, which coordinate with business systems.

*As the products introduced in this paper are mainly sold for the domestic market, some figures feature explanations by the Japanese Language.

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