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WIMAX BASED APPROACH TO ENHANCE LOCALIZED HUMAN SOCIAL NETWORK

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Abstract: The Internet is the most essential networking environment in the world. As more Internet applications become commonplace, more people want to use Internet applications with any device at any time or place. Therefore, as wireless networking becomes a mainstream reality for businesses and consumers, forward-thinking cities are moving to deploy high-bandwidth, citywide networks to support government workers, local businesses and residents. The World Wide Web (simply the "Web"), accessible via the Internet, has been the common information platform that can heavily impact the human life style and social relationships. However, traditional Web has limitations of interactivity and performance. Moreover, the client-server architecture obstructs information interchange. Additionally, most Web applications are only designed for conventional computers, not for mobile handheld devices which are becoming increasingly popular. Consequently, various designs including Web 2.0, Community 2.0, peer-to-peer architecture, Internet-scale operating system and etc are proposed to improve these shortcomings. Nevertheless, these systems are currently in developing or actually do not yet exist due to their complicated designs. Based on the above, we propose a concise connectivity approach capable of increasing the serviceableness of web in wireless citywide environments. In this approach, the distributed HTTP daemon, in conjunction with trusted global storage technologies, can be established. Next, the community-oriented grouping mechanism using global naming scheme can then be presented. Moreover, a practical information classification method for virtual community applications can also be constructed. This proposed community-oriented approach can not only support the use of mobile handheld devices in wireless citywide environments, but also can significantly improve the interactivity of information and enhance the localized human social network.

Keywords: Wireless City, Web, Community, Trusted Storage, Locality

I. INTRODUCTION

The Internet is a collection of interconnected computer networks; it's the most essential networking environment in the world. As the Internet rapidly evolves, there are 1.09 billion people use the Internet today. With the development of wireless communications technologies and novel designs of mobile handheld devices, the general public can use the Internet with any device at any time or place. Except for accessing Internet ubiquitously, the other trend of using Internet is to sharing useful content on Web, not just retrieving as much information as possible from Web sites. Thus, Web 2.0 [1], Community 2.0, and the like play critical roles of the coming Internet revolution.

Wireless technologies, such as WiFi [2], WiMAX [3], and etc, can offer more convenient and easier way than wired communications to connect Internet. Wireless networks have significantly impacted the world in these years. With the use of wireless networks, information could be sent oversees easily and quickly and was more reliable. Wireless networks have continued to develop and their uses have obviously grown. As wireless networking becomes a mainstream reality for businesses and consumers, forward-thinking cities are moving to deploy high-bandwidth, citywide wireless networks to support government workers, local businesses and residents. The most famous ongoing wireless city projects are including Wireless Philadelphia [4], Google WiFi Mountain View [5], Wireless Taipei City [6], and San Francisco TechConnect project [7]. As wireless technologies speedily developed, wireless citywide environment becomes the primary connectivity way for residential citizens to connect Internet.

Mobile handheld devices are becoming important equipments when people accessing Internet due to the capabilities of mobility and easy taking-along. How to serve ubiquitous applications by using mobile handheld devices has received increasing attention. Murugesan and Venkatakrishnan [8] addressed the challenges of Internet-based applications on mobile handheld devices. Hu et al. [9] then examined how to use Internet-enabled mobile handheld devices for mobile commerce. With emphasizing the importance of mobile handheld devices when applying Internet-based applications and mobile computation, the designers of new devices and applications are promoting the adoption of high-throughput, low latency and QoS functionality. As a result of adopting these functionalities, mobile handheld device will receive more attention and

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work, resulting in new features and improvements in speed, security, and reliability. In turn, these advances will spur increased use. Some potential mobile handheld devices are listed as follows:

– Data centric devices: lightweight laptops, PDAs

– Consumer Electronics devices: game consoles, MP3 players

– Voice and voice/data devices: cellular phones, smart phones

The World Wide Web ("WWW" or simply the "Web"), accessible via the Internet, is a collection of interconnected documents and other resources. The Web has been the most popular application of the Internet due to its capabilities of feasibility, distributed computation, and support of various types of information. The Web technology is continuously evolving; except for the contributions of information retrieving, the Web allows global interpersonal exchange. People separated by vast distances, or even large amounts of time, can use the Web to exchange or even mutually develop their most intimate and extensive thoughts, or alternately their most casual attitudes and spirits. Emotional experiences, political ideas, cultural customs, musical idioms, business advice, artwork, photographs, literature, can all be shared and disseminated digitally with less individual investment than ever before in human history.

Although the existence and use of the Web relies upon material technology, its information does not use physical resources in the way that libraries or the printing press have. Therefore, propagation of information via the Web is not constrained by movement of physical volumes, or by manual or material copying of information. By virtue of being digital, the information of the Web can be searched more easily and efficiently than any library or physical volume, and vastly more quickly than a person could retrieve information about the world by way of physical travel or by way of mail, telephone, telegraph, or any other communicative medium. The Web can not only be seen as a common information platform, but also heavily impact the human social relationships.

However, traditional Web has limitations of interactivity and performance. The Web's client-server architecture obstructs information interchange. Additionally, most Web applications are only designed for conventional computers, not for mobile handheld devices. Thus, we determined to propose a novel connectivity approach that supports trusted, ubiquitous, community-oriented applications via using mobile handheld devices in wireless citywide environments. The rest of this paper is organized as follows. Section 2 describes the deficiencies of traditional web including its unavailability and less interactivity. Section 3 then introduces the concepts of the improved Web 2.0 and the Internet-scale Operating System that can be seen as the baseline of our proposed approach. Next, Section 4 describes our proposed community-oriented connectivity approach. Additionally, Section 5 demonstrates a sample scenario constructed by the proposed approach, and then highlights implementation considerations. Conclusions are finally drawn in Section 6, along with recommendations made for future research.

II. DEFICIENCIES OF TRADITIONAL WEBS

The Web has developed more than two decades since the end of the 20th century. Although Web can be seen as the most essential application of the Internet today, it has various shortcomings due to its outmoded designs such as client-server architecture. Figure 1 depicts the client-server architecture of traditional web. In such client-server model, all the web resources, mostly the Web Pages, are handled by Web servers. The traditional Web server is constructed by using HTTP daemon. The users in Internet, as the Web clients, use Web browsers to connect to Web servers to request Web-based services. Such client-server model is easily deployed but has lots of limitations and security risks. Some possible drawbacks are including:

– Unbalanced loads:

Obviously, the Web server has to take the most loads in each service session. Traffic congestion has always been a problem. When a large amount of clients send requests to the same server at the same time, it would cause a lot of troubles for the server. The more clients there are the more troubles it has. Additionally, as more Internet applications transformed to Web-based ones, Web servers have to improve their capabilities of supporting various applications with multimedia data by arising system performance to afford more working loads.

Thus, Web server is always the bottleneck of traditional Web computing. Moreover, when the server is down, clients' requests cannot be fulfilled. The error message of accessing Web sites, such as "404 Error: File Not Found", "Host Unavailable", means that Web is not always-on due to overload work or some malicious attacks. That is, the Web server in the client-server architecture will be the "single point of failure".

– Highly attack treats to Web servers:

– Controversial issues of intellectual property

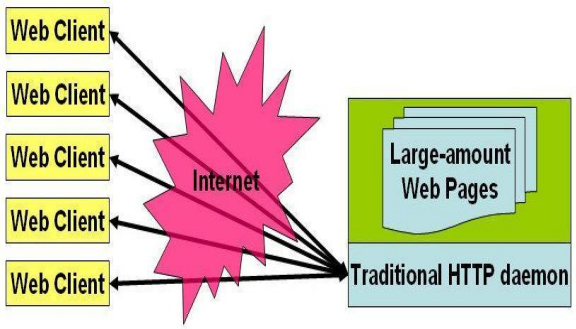

Figure 1. Client-server based Web computing

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To overcome the shortcomings of conventional client-server Web, Peer-to-peer (P2P) Web was proposed. A P2P network does not have the notion of clients or servers, but only equal peer nodes that simultaneously function as both "clients" and "servers" to the other nodes on the network. This model of network arrangement differs from the client-server model where communication is usually to and from a central server. An important goal in P2P networks is that all peers provide resources, including bandwidth, storage space, and computing power.

Thus, as nodes arrive and demand on the system increases, the total capacity of the system also increases. The distributed nature of P2P networks also increases robustness; there is no single point of failure in P2P systems. Figure 2 represents the P2P Web by use of distributed HTTP [10] daemon. Although the distributed HTTP daemon is easily implemented and the P2P Web method can apparently avoid the limitations of conventional client-server Web model, the P2P Web has the following disadvantages:

– Inadequate for information linking:

– Less capability of lightweight peer:

As described above, neither traditional Web nor P2P Web based on adopting distributed HTTP daemon can support Web-based applications which require frequent interactivities via using mobile handheld devices. Thus, we need a modified P2P Web model. The new model is based on P2P Web. The new model should be global-scale. The new model should support community-oriented information interchange. The new model should also provide the use of mobile handheld devices in wireless citywide environments. To build such a new model, we refer to the concepts of Web 2.0 and Internet-scale operating system.

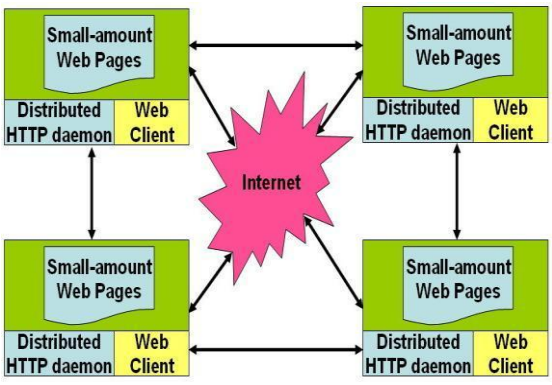

Figure 2. Peer-to-peer based Web computing

III. WEB 2 AND INTERNET-SCALE OPERATING SYSTEM

In term of information interchange on the Web, the new Web 2.0 is recommended. Web 2.0 is the business revolution in the computer industry caused by the move to the Internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules is this: Build applications that harness network effects to get better the more people use them. Web 2.0 refers to a perceived or proposed second generation of Internet-based services, such as social networking sites, wikis, communication tools, and folksonomies, which emphasize online collaboration and sharing among users. Web 2.0 provides a new concept of information interchanging and experiences sharing on the Web by using technologies including Rich Internet Application (RIA).techniques, Cascading Style Sheets, Weblog publishing, and the like.

As mentioned above, Web 2.0 is helpful to social networking such as building a virtual community. A virtual community or online community is a group of people that may or may not primarily or initially communicate or interact via the Internet. Virtual communities have also become a supplemental form of communication between people who know each other in real life. Today, virtual community can be used loosely for a variety of social groups interacting via the Internet. It does not necessarily mean that there is a strong bond among the members. Virtual communities depend upon social interaction and exchange between users online. This emphasizes the reciprocity element of the unwritten social contract between community members. Recently, community-based Web sites are the fastest growing sites on the Internet. Virtual communities may synthesize Web 2.0 technologies with the community, and therefore have been described as Community 2.0. Community 2.0 is about user-generated content and collaboration. It is a contribution culture. It is all the more prevalent because the community now comes with us through handheld devices, phones, or laptops. It is mobile, it is ubiquitous, and it is continuous computing. Virtual communities based on Web 2.0 are including Flickr, Facebook, and etc.

In terms of global-scale model, the Internet-scale operating system (ISOS) [11] is worthy referenced. An ISOS consists of a thin layer of software (an ISOS agent) that runs on each “host” computer (would be a peer node in P2P Web) and a central coordinating system that runs on one or more ISOS server complexes. This veneer of software would provide only the core functions of allocating and scheduling resources for each task, handling communication among host computers and determining the reimbursement required for each machine. This type of operating system, called a microkernel, relegates higher-level functions to programs that make use of the operating system but not a part of it. Two broad types of applications might benefit from an ISOS. The first is distributed data processing; the second is distributed online services. The core facilities of an ISOS include resource allocation (long-term assignment of hosts’ processing power and storage), scheduling (putting jobs into queues, both across the system and within individual hosts), accounting of resource usage, and the basic mechanisms for distributing and executing application programs.
Nevertheless, an ISOS system does not exist yet, the techniques for achieving ISOS system are developing. Today, designers have already produced a number of

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Internet-scale, or P2P, applications that attempt to tap the vast array of underutilized machines available through the Internet.

IV. THE COMMUNITY-ORIENTED CONNECTIVITY APPROACH

As discussed in section 2 and section 3, we should develop a global-scale Web model capable of information interchange and the support of using mobile handheld devices. To do so, a community-oriented connectivity approach is proposed. In this approach, the distributed HTTP daemon, in conjunction with trusted global storage technologies, has to be established. Next, the community-oriented grouping mechanism using global naming scheme has to be presented. Moreover, the information classification method for virtual community applications has also to be constructed. The proposed community-oriented approach can increase the serviceableness of web in wireless citywide environments.

The functional diagram of the proposed community-oriented connectivity approach is depicted as figure 3. The functions of this approach are described as follows:

– Wireless technologies

The WiFi and WiMAX technologies are used to build a wireless citywide
environment.

– Internet

The Internet is still the suggested networking platform.

– Peer-to-peer Web

– User-relative naming mechanism

– Global storage technology

– Information classification method

– Security related technologies

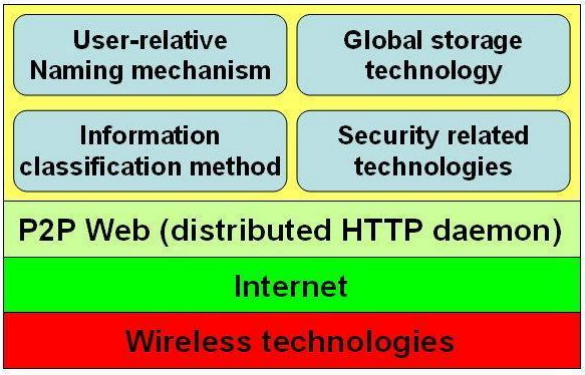

Figure 3. Functional diagram of the community-oriented connectivity approach

Base on the above functions, we build a trusted P2P always-on Web shown in figure 4. The page handler agent is a broker that can handle the page-accessing processes including transformation, encryption/decryption, dispatching, and etc. To fulfill the demand of interactivity and information sharing for Web 2.0 applications, the RIA-based enabled Web Pages are adopted. Thus, the P2P based HTTP daemon in conjunction with trusted global storage technology can achieve the need of always-on Web.

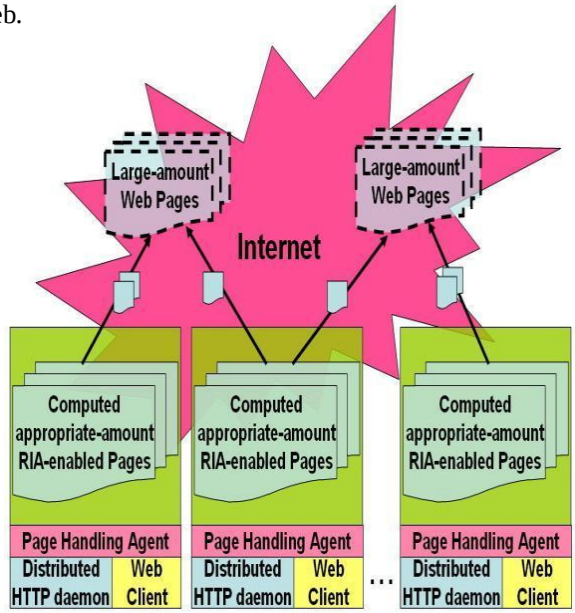

Figure 4. Always-on Web by using the proposed connectivity approach

V. APPLICATION SCENARIO AND IMPLEMENTATION ISSUES

In this section, we provide an application scenario. This scenario is based on our proposed community-oriented connectivity approach. Because virtual communities have become a supplemental form of communication between people who know each other in real life, we build a virtual community for residents who live locally in geographical neighborhood areas as an example of using our proposed approach. A community refers to a group of people who interact and share certain things as a group. Hence, People live locally in geographical neighborhood areas certainly form a geographical community as shown in figure 5. In such geographical community, residents experience same environmental issues including pollution, noise, traffic problems. People live in same geographical community have same duty and right because of the same administrative division. People live in same geographical community have similar housing conditions as well. In other words, people live in same geographical community actually have the demand of sharing local information. However, it's difficult for geographical residents to share local information face to face because of separated space and personal privacy concerns. To solve this problem today, people use virtual community channel such as Yahoo Groups to build a virtual community to share their local geographical information and housing experiences. Nevertheless, such Web-based applications are conventional. Our proposed community-oriented connectivity approach is a better solution to construct trusted virtual community for such need. Additionally, locality is an important attribute of deploying our approach. Locality with three main benefits of latency, reliability, and bandwidth can heavily enhance the performance of our proposed approach. Consequently, a virtual community based on geographical community is a thinkable scenario of adopting our community-oriented connectivity approach.

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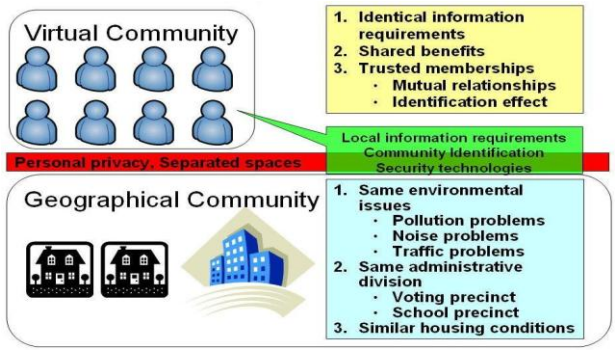

Figure 5. Scenario of virtual community over geographical areas

In terms of the implementation of our proposed approach, we begin with constructing a wireless citywide environment based by WiFi and WiMAX technologies as depicted as figure 6. In this wireless environment, the WiFi and WiMAX duel mode devices can be used. The WiFi, WiFi mesh, Fixed WiMAX, and Mobile WiMAX technologies can be the connectivity means of connecting to Internet, these wireless technologies form a wireless citywide environment suitable for adopting our proposed community-oriented approach. In the next steps, we are going to complete the following implementation issues:

– Peer-to-peer Web

We are going to construct a testbed of P2P Web in our current wireless city environment. The distributed HTTP daemon will be implemented.

– User-relative naming mechanism

We are surveying suitable user-relative,

content-based naming solutions. Basically, the global naming methodology over the Unmanaged Internet Architecture proposed by Ford et al. [21][22] will be referenced.

– Global storage technology

We are looking for global storage technology with security necessary mechanisms. Basically, the OceanStore technology will be referenced.

– Information classification method

We are surveying information classification methodologies, and then we will try to build policies of verifying data based on community subjects, attributes, and the relatives.

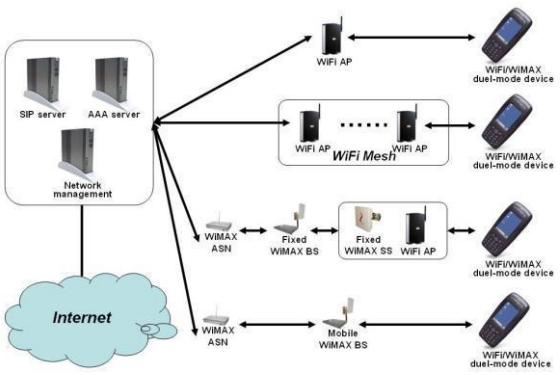

Figure 6. WiFi and WiMAX interworked wireless citywide environment

CONCLUSIONS

In this paper, we propose a concise connectivity approach capable of increasing the serviceableness of web in wireless citywide environments. The novel peer-to-peer http daemon, in conjunction with trusted global storage technologies, is suggested. The community-oriented grouping mechanism using global naming scheme is essential. And a practical information sharing method supporting mobile handheld devices is necessary. To achieve the proposed community-oriented approach which can significantly improve the interactivity of information and enhance the localized human social network, we have built a WiFi and WiMAX interworked wireless environment as the testbed for further researches. In the next steps, the trusted global storage technology, the community-based naming mechanisms, and the practical information classification method are continuously studying. Ubiquitous computing is the trend of the next generation Internet. Web 2.0 based applications served by mobile handheld devices in wireless communications environments can heavily impact human life style in the future.\

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