TaskShadow-W: NFC-triggered Migration of Web Browsing across Personal Devices

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Abstract

The era of "multiple devices per user" brings a new requirement of cross-device task migration. Web browsing is one of the most frequent activities in daily life, however it still lacks an effective mechanism to support user-friendly migration of web browsing across multiple devices. In this paper, we develop the TaskShadow-W, an NFC-triggered web session migration system, to address this issue. TaskShadow-W provides the functionality of session management to guarantee the continuous experience of web browsing. It supports an NFC-based interaction to activate the migration in a user-friendly way. The system is compatible with most of the existing websites, and does not require dedicated proxy servers or modifying the existing web servers. In addition, it is also easy to learn & use.

Author Keywords

Web Session Migration; NFC; Cross-Device Interaction

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Design, Human Factors

Introduction

The number of devices that a user owns is increasingly growing, such as smartphones, tablets, laptops, desktops. The new paradigm of "multiple devices per user" provides opportunities for users to engage in tasks that span multiple devices, which has brought a new requirement for ubiquitous computing: cross-device task migration.

The web browsing is one of the most frequent activities in users' daily life. A user often encounters the situation that he/she switches to another device to continue the task of web browsing. For example, users access their unread emails with mobile phones on the move, and continue to handle some emails (reply or view the attachments) with desktops when reach the destination. Bales et al. further indicated the demand of web migration is bidirectional between the mobile device and desktop [1]. However, it is still painful for users to achieve the cross-device migration of web browsing. Users have to resort to manual methods. Emerging cloud storage technologies make information ubiquitously available. But it currently lacks the mechanism of session management to guarantee the continuous experience of web browsing.

To solve this problem, we develop the TaskShadow-W to achieve web session migration across multiple devices. We design a session management method to describe and capture the session state, so as to guarantee the continuity of cross-device web browsing. This method does not require the dedicated proxy servers or modifying the existing web servers. We also

introduce an intuitive and natural interaction to automatically trigger the migration. It can significantly reduce users' operational burden.

Why NFC?

There are many ways to trigger the migration between devices. Location-based triggering approach [2] can complete the migration transparently, but it requires additional positioning systems and its process is not controllable. MagicPhone [3] combined pointing and gesture to select and control in-door devices, but it still requires the support of positioning systems. QR codes scanning [4] can also be used to automatically trigger the migration. However, it draws user attention heavily to the camera view and may fail in dark environment.

NFC (Near Field Communication) [5] is a wireless communication technology that uses electromagnetic wave to detect object approximation at a short distance. Compared with the approaches mentioned above, NFC interaction is more convenient and intuitive in practice.

TaskShadow-W: Components and Functionalities

TaskShadow-W consists of two components (shown in Fig. 1): the NFC-enabled mobile side and the desktop side attached with an NFC-tag. Both components support the preservation and restoration of web session, and communicate with each other to exchange information. The mobile side is also responsible for triggering the migration.

TaskShadow-W mainly provides four functionalities: 1) Bidirectional migration: it supports two-way migration between the mobile device and desktop; 2) Session continuity: It supports the preservation and restoration

of session status between different devices; 3) User-friendly interaction: It utilizes the touch as a triggering approach to automatically complete the process of migration; 4) Security management: It encrypted the session information to prevent the leakage of personal data. In additional, it provides a safe mode to immediately delete the session data on the desktop after the migration.
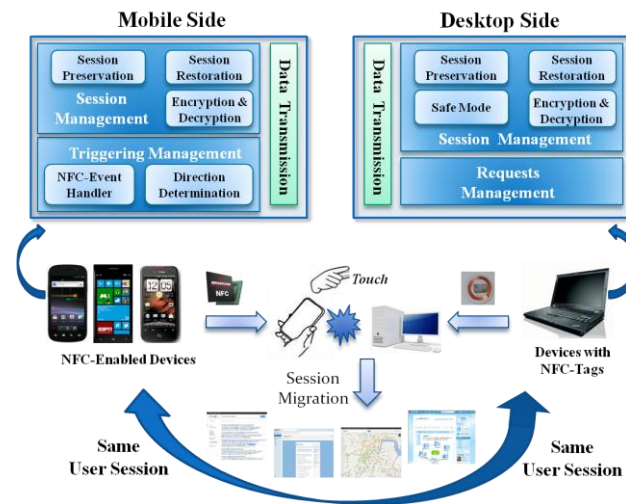

Figure 1. System Overview.

How does TaskShadow-W work

TaskShadow-W provides a user-friendly way for users to complete a bidirectional migration across multiple devices, along with continuous session state. In this section, we will explain the detail methods.

How to describe the session state
To avoid deploying dedicated proxy servers or modifying the existing web servers, we employ the

session information collected on the browser to approximately represent the session state. We use four types of information to describe the session state: 1) URL (Uniform Resource Locator): the address of the Internet standard resource; 2) Cookie: record the state information of the site or the activity a user had taken in the past; 3) Flash data: record the playing information, which is important for video sites that use Flash; 4) User inputting: the information that users input in the current page, such as search keywords, etc. Although this description cannot support some special sites such as online banking websites, it is compatible with most of the existing websites.

How to automatically establish the connection between devices
Touch is a natural and intuitive way for a user to select his/her target device, which is well supported by NFC technology. Due to the low bandwidth of NFC, other transmission technology (e.g. Wi-Fi) is required for data communication. However, it is cumbersome for users to manually configure the network. So, we encapsulate devices' connection information (includes IP address and port) into NFC tags, and employ the touch to automatically establish the connection between devices.

How to automatically determine the direction
We design a direction determination method based on recent operation time (*ROT*), to support the two-way migration. The *ROT* refers to the last time that a user operates with a web client. The process of the method is as follows: 1) It is activated when a user touches a deployed NFC-tag with the mobile device; 2) The mobile side communicates with the desktop side to acquire the *ROT* of desktop side (t_1). Simultaneously, it

Another Example: Migration between Mobile Phone and Tablet

1) A user visits a social networking site (weibo.com) on a smart phone, and then touches the NFC-tag of a tablet with the phone.

2) The accessing page is seamlessly migrated to the tablet for continuously browsing.

queries its own *ROT* (t_2); 3) The mobile side compares t_1 with t_2 to determine the migration direction. If t_1 is earlier than t_2, the migration direction is from mobile side to desktop side. Otherwise, vice versa.

Deployment and Usage

We develop a Chrome plug-in and Java-based daemon to realize the desktop side, and deployed it on a laptop (Window OS). We also develop an android application to realize the mobile side, and deployed it on Google Nexus-S (Android OS). The NFC-tag deployed on the laptop encapsulates connection information. The two devices communicate with each other via Wi-Fi.

Figure 2. Usage Illustration

We use a scenario of email browsing to illustrate the usage of the system (as shown in Figure 2):

1. A user is using a laptop to browse his/her emails on an email site (mail.163.com);

2. Before left, he/she touches the NFC tag deployed on the laptop with the mobile phone;

3. The visiting page is seamlessly migrated to the mobile device, and the user can continue to access the original emails on the move.

The usage for the migration from mobile side to desktop side is similar to the above process, except that a user is firstly visiting pages on the mobile device.

Acknowledgements

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