

Privacy in Cross-System Personalization

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Abstract

Cross-system personalization (CSP), an innovative technology that enables consistent personalized user experience across different applications, platforms and even devices, is gaining substantial momentum both in academia and industry. Despite the potential benefits to both service providers and end users, CSP raises thorny privacy issues. This paper discusses these potential privacy issues in CSP and suggests directions for future research.

Introduction

Cross-system personalization (CSP) refers to “personalization that shares information across different systems in a user-centric way” [1]. In a converged service environment, CSP enables services or applications that adapt to each user based on the user’s service consumption data from multiple service domains (e.g., music and news) and multiple service platforms (e.g., IPTV and mobile phone) [2]. Imagine the personalized radio (e.g., Pandora) on your smart phone plays music (partially) based on what news and shows you watched on your IPTV and/or the Youtube videos you saw on your laptop. CSP has the potential to strengthen the benefits of personalization: further engage and retain end users, help justify targeted ads, etc. However, since CSP usually relies on collecting, merging and mining user data gleaned from multiple applications/platforms, it faces privacy requirements from privacy legislation as well as end user privacy concerns.

Legal Requirements

Privacy laws and regulations usually lay out both organizational and technical requirements for information systems that store and/or process personal data, in order to ensure the protection of these data. Those requirements prescribe proper data acquisition, retention, transfer, and processing [3]. Our earlier work involved an analysis of impacts of various European Union directives¹ and over 40 countries’ privacy legislation on personalization, in general

¹ EU member states need to implement the requirements from these EU directives into their own privacy legislation.

[4]. Here we discuss several aspects of legal privacy requirements that are particularly relevant to CSP.

Purpose-specific Data Collection and Usage.

Czech Republic Privacy Act [5] mandates that:

personal data that were obtained for different purposes may not be grouped.

German Teleservices Data Protection Act [6] requires that:

Personal profiles retrievable under pseudonyms shall not be combined with data relating to the bearer of the pseudonym.

These legal requirements reflect a fundamental privacy principle that underlines many privacy laws – purpose-specific data collection and usage. This principle conflicts with the practice of merging data across multiple sources (and presumably collected under different purposes). Without users’ consent (opt-in), one may question the legality of CSP driven by merging and sharing user data across applications.

Parsimonious Data Retention and Processing

Another related privacy principle has to do with data parsimony – only collect and use data to the extent that it is needed. For instance, German Teleservices Data Protection Act [6] also requires that:

usage data must be erased immediately after each session except for very limited purposes².

This specification could affect CSP systems that utilize a user’s usage data across sessions, let alone usage data across different systems over a long period of time. This data parsimony principle may again put CSP systems that rely on tracking users across sessions and applications into question.

CSP Deployed across Different Jurisdiction

Many service providers (e.g., Alcatel-Lucent) that espouse the idea of CSP are internationally operated. That is to say their CSP systems are likely to be deployed to different

² Examples include fighting fraud and bill tracking.

countries and thus need to observe different jurisdiction. Therefore a CSP system operates lawfully in one country may backfire in other country. CSP designers need to take this into consideration. Our previous work proposed a software architecture approach that mitigates this problem in web personalization [3]. We plan to investigate the applicability of this approach in the context of CSP.

End User Privacy Concerns

Teltzrow and Kobsa [7] present a meta-analysis of various studies of web users privacy concerns and their impacts on personalized systems. They conclude that web users are not only quite concerned about being tracked online but also counteract, e.g., providing false information to websites. This dramatically affects CSP because the system needs to track a user across multiple applications. It should be noted that there is a dearth of academic knowledge/research of end user's privacy concerns regarding tracking them across systems. A better understanding of users' privacy concerns in the context of CSP is a prerequisite for usable solutions.

Future Research Directions

Privacy is not a new research topic for personalization. There are many existing privacy knowledge and techniques that we can build upon. In the area of usable privacy and security [8], researchers have been studying people's privacy concerns and practices in various contexts (e.g., [9]) and developing usable end-user privacy management tools (e.g., [10]). However, to what extent these privacy concerns and tools apply in the context of CSP is still an open question.

In the area of privacy-enhanced personalization [11], most solutions follow either an architectural approach that the personalization system architecture respects certain privacy constraints (e.g., [3]) or an algorithmic approach in which the personalization algorithms manifest some privacy-preserving characteristics (e.g., [12]). There is virtually no work on empowering end users to manage their privacy in personalization. One exception is scrutable personalization [13] in which tools are provided to enable end users to scrutinize the underlying user model and adaptation process primarily in educational settings.

We highlight the following directions that may be particularly fruitful.

In-situ Privacy Setting Collection

When a user starts an application for the first time, it asks the user whether it can access her user profile to personalize the interactions thereon. When she finishes interacting with an application, it will ask her whether her service consumption data with it can be used to update her user profile. The rationale behind this is that privacy is situational [14] and users may make privacy decisions more easily right in the context rather than in a privacy

setting panel isolated from the situation [15]. Nevertheless, there will be a global privacy setting panel that allows users to change their privacy decisions at any time.

Privacy Sampling

Because of the potentially large number of applications, we do not want to overwhelm our users by asking them for their preferences every time they encounter a new application. One simplification is to do "privacy sampling" – each user is only asked to provide a small set of privacy decisions initially. The CSP system will (incrementally) build a privacy model for each user that can predict his/her unspecified privacy decisions. Users can of course choose to override these predicted privacy settings as they wish. One case of applying this strategy in an application for sharing location info between friends yields quite high (about 90%) prediction accuracy [16].

Visualization of Privacy Settings and Support for Social Navigation

We can create intuitive visualizations of individual users' privacy settings (e.g., [17] for privacy policy). We also can explore the idea of social navigation [18] in this context – providing visualizations of other people's (friends and families) or group's privacy settings. For example, knowing aggregated statistics, such as the percentage of users who chose to disclose a particular piece of service consumption data, may help users make their own decisions [19].

Client-Side Personalization

The system can store all service consumption data of a user on his/her own device (PC, or powerful mobile phone) and perform the personalization computation on the device. Users would tend to have less privacy concerns since their data resides on their devices rather than some centralized data server.

Conclusion

Cross-system personalization has huge potential of transforming user experience and boosting business, but considerable privacy issues remain to be resolved. We advocate more privacy research into this emerging area.

References

- [1] B. Mehta, C. Niederee, A. Stewart, M. Degemmis, P. Lops, and G. Semeraro, "Ontologically-Enriched Unified User Modeling for Cross-System Personalization," *User Modeling 2005*, 2005, pp. 119-123.
- [2] A. Aghasaryan, S. Betgé-Brezetz, C. Senot, and Y. Toms, "A profiling engine for converged service delivery platforms," *Bell Lab. Tech. J.*, vol. 13,

- 2008, pp. 93-103.
- [3] Y. Wang and A. Kobsa, "Respecting Users' Individual Privacy Constraints in Web Personalization," *UM07, 11th International Conference on User Modeling, C. Conati, K. McCoy, and G. Paliouras, eds., Corfu, Greece: Berlin - Heidelberg - New York: Springer-Verlag, 2007, pp. 157-166.*
- [4] Y. Wang and A. Kobsa, "Impacts of Privacy Laws and Regulations on Personalized Systems," *PEP06, CHI06 Workshop on Privacy-Enhanced Personalization*, A. Kobsa, R.K. Chellappa, and S. Spiekermann, eds., Montréal, Canada: 2006, pp. 44-46.
- [5] CZ, "Act 101 of April 4, 2000 on the Protection of Personal Data and on Amendment to Some Acts," 2000.
- [6] DE-TS, "German Teleservices Data Protection Act, as amended on 14 Dec. 2001," 1997.
- [7] M. Teltzrow and A. Kobsa, "Impacts of User Privacy Preferences on Personalized Systems - a Comparative Study," 2003, pp. 315--332.
- [8] L.F. Cranor, "Towards usable Web privacy and security," *Proceedings of the 14th international conference on World Wide Web*, Chiba, Japan: ACM, 2005, pp. 352-352.
- [9] N. Sadeh, J. Hong, L. Cranor, I. Fette, P. Kelley, M. Prabaker, and J. Rao, "Understanding and capturing people's privacy policies in a mobile social networking application," *Personal Ubiquitous Comput.*, vol. 13, 2009, pp. 401-412.
- [10] C. Brodie, C. Karat, J. Karat, and J. Feng, "Usable security and privacy: a case study of developing privacy management tools," *Proceedings of the 2005 symposium on Usable privacy and security*, Pittsburgh, Pennsylvania: ACM, 2005, pp. 35-43.
- [11] A. Kobsa, "Privacy-enhanced personalization," *Commun. ACM*, vol. 50, 2007, pp. 24-33.
- [12] B. Mehta, "Learning from What Others Know: Privacy Preserving Cross System Personalization," *Proceedings of the 11th international conference on User Modeling*, Corfu, Greece: Springer-Verlag, 2007, pp. 57-66.
- [13] M. Czarkowski and J. Kay, "A Scrutable Adaptive Hypertext," *Proceedings of the Second International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems*, Springer-Verlag, 2002, pp. 384-387.
- [14] L. Palen and P. Dourish, "Unpacking "privacy" for a networked world," *Proceedings of the SIGCHI conference on Human factors in computing systems*, Ft. Lauderdale, Florida, USA: ACM, 2003, pp. 129-136.
- [15] R. de Paula, X. Ding, P. Dourish, K. Nies, B. Pillet, D.F. Redmiles, J. Ren, J.A. Rode, and R. Silva Filho, "In the eye of the beholder: A visualization-based approach to information system security," *International Journal of Human-Computer Studies*, vol. 63, Jul. 2005, pp. 5-24.
- [16] P.G. Kelley, P.H. Drielsma, N. Sadeh, and L.F. Cranor, "User-controllable learning of security and privacy policies," *Proceedings of the 1st ACM workshop on Workshop on AISec*, Alexandria, Virginia, USA: ACM, 2008, pp. 11-18.
- [17] R.W. Reeder, P.G. Kelley, A.M. McDonald, and L.F. Cranor, "A user study of the expandable grid applied to P3P privacy policy visualization," *Proceedings of the 5th Symposium on Usable Privacy and Security*, Mountain View, California: ACM, 2009, pp. 1-1.
- [18] A. Dieberger, P. Dourish, K. Höök, P. Resnick, and A. Wexelblat, "Social navigation: techniques for building more usable systems," *interactions*, vol. 7, 2000, pp. 36-45.
- [19] Sameer Patil and Alfred Kobsa, "Enhancing Privacy Management Support Instant Messaging," *Interacting with Computers*, Forthcoming. .