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# User Experience in the Cloud: Towards a Research Agenda

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## Abstract

Cloud is a new interaction, development and service delivery paradigm in which services and data are stored in servers managed by external parties. User experience (UX) is an important design target and success measure for new services, especially when the users have plenty of choice within the quickly expanding service offering. From the user's point of view, the cloud concept may facilitate better user experience but the concept may also raise new challenges. UX targets for the cloud are still undefined in research. In this paper, we will identify key user experience issues related to cloud services in six design and evaluation cases. Based on the findings, we propose research questions for initial research agenda on UX in the cloud.

## Keywords

Cloud services, user experience, research agenda

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

## General Terms

Design, Human Factors

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## User experience and the Cloud

The software industry is currently experiencing a paradigm shift from traditional installable applications to web-based software, where applications live on the Web as services. They consist of data, code and other resources that can be located anywhere in the world, on remote servers “in the cloud”. Cloud computing is a step towards the future vision that computing will be an utility similar to water, electricity or telephony [2].

Miller [5] lists user benefits of cloud computing: With cloud computing users do not have to take care of updating software to newer versions but the newest version is always available. The user can have unlimited memory capacity on the cloud, and the data is automatically secured and backups are taken care of. With cloud solutions the users do no more face compatibility problems with different operating systems, different file formats or software versions. When user’s documents are stored in the cloud, the user has universal access to the data anywhere and always has the latest version at hand. User terminals can be more modest and cheaper than today as they need less local processing power and storage.

There are also threats related to cloud computing. Cloud computing relies on continuous, fast Internet connections. Those connections are not self-evident. In web-based applications features may be limited compared to local applications [5]. Security may become a threat if the user does not know where the data is stored, who has access to it, and how, where and for what purposes different data is combined. In principle, data in the cloud is safe and replicated across multiple machines. But if the data does go missing, the user will not have physical or local backup [5].

Our focus in the developing cloud paradigm is on user experience (UX). We investigate the research questions from the end-users’ perspective, which has been emphasized less in the past than the viewpoints of technical developers and administrators of cloud services. UX includes user’s perceptions of the practical aspects of the system (e.g., utility, reliability, and usability) and the emotional aspects related to system use (e.g., attractiveness and enjoyability) [4].

We are involved in a large, industry-lead Cloud SW research program [3] in which one of the major perspectives is “superior user experience”. The aim is to integrate UX targets and development efforts in the multitudes of R&D cases of the program. This research is to ensure the business success of new Cloud technologies and applications.

With this position paper we aim at setting the scene for Cloud UX research. Based on existing cases in the Cloud SW program and other projects, we propose initial but central research questions for the field.

## Example cloud UX cases

In the following we describe six design and evaluation case studies that we have carried out so far.

### OPEN TELCO

Open Application Programming Interfaces (APIs) have been identified as one of the key elements in the Web 2.0 paradigm, driving service creation and innovation, as well as attracting developers and users to the market. Open Telco is an open API framework for mobile networks. It gives external developers access to the data and functionalities traditionally possessed by teleoperators. [6]

Via the cloud external service providers can be given access to Open Telco interfaces and further user data such as user profile, location, call and location history, mobile payment and network presence. In our user studies, promising Open Telco value proposals were e.g.:

- Universal user profile fits all services.
- Peer recommendations based on user profile and location.
- Effective mobile ticketing, e.g. event organizers have contacts to the ticket owners from the moment they buy the ticket.

#### CLOUD OF THINGS

*Cloud of Things* services connect information from the cloud with objects in the physical world. We have been studying a use case where people can get various information about groceries to support their purchasing decisions. The information can be related to the ingredients of the product or ethical consumption, providing consumers information e.g. about the carbon footprint of the product or the production conditions. The information can be also hints provided by peers based on their experiences. The customer gets personalised product information with his/her mobile device as different augmented reality features.

In addition to the shopping assistance, Cloud of Things services can also be used to monitor and gather long-term data of user's shopping behaviour. People can monitor their own or social trends. Once you see a trend, you can try to change it to a better direction. Persuasive services can change individual person's or communities' behaviour to healthier or more

sustainable direction. In these services playfulness and joy as well as extreme ease of use are crucial.

#### SOCIAL TV

In another cloud case, we have studied user interaction with Social TV. Social TV refers to a concept where people can easily and in real time share their viewing experience, comments and recommendations with their friends. According to our study, most participants already comment TV content in (almost) real time to people not physically present. Used means of communication were chat, Facebook, irc, and SMS. With regards to future services, commenting sports and reality TV (e.g. Dance, Idols) are particularly interesting for social TV. Recommendations about programs and movies were found interesting. Privacy issues, e.g. revealing one's TV habits, concern most of the participants.

#### MOBILE WEB BROWSING

Another case study is on mobile web browsing user experience [7]. Although this work focused on a mobile web browser and the means to view large pages on small screens, the role of the content on the web sites was highlighted as the primary source for user experience. When the cloud service is delivering content from external content providers to the user, the service itself should not 'steal the show' but let the content be experienced as the content provider designed it. When the same content is accessed from several types of devices, it is challenging, however, for service developers to deliver all kinds of content as originally meant by the content provider. If the content itself is flexible in format or designed for the different devices, it is much more probable that the user

experience is not ruined by the cloud service used for accessing the content.

#### PHOTO SHARING THROUGH A CLOUD SERVICE

In a user experience study of a mobile photo sharing service called Nokia Image Exchange it was found out that services need to be seamlessly linked with other services in the Cloud. Services should also be accessible on multiple devices which fit best to the task at hand. Furthermore, when the connection to Cloud is not available, offline use cases should be supported, e.g. recently created photos stored locally. Also, the social community building should be made efficient, in specific users' contact network building needs to be automated. Finally, even though privacy was not raised as a main concern in this study, user's feeling of control over their data needs to be ensured. [8]

#### CROSS-PLATFORM SERVICE ACCESS

In a field study of UX of three cross-platform Web 2.0 services (Facebook, Nokia Sports Tracker and Dopplr), it was found out that users tasks were to some extent specific to the given platform (access device, e.g. mobile device and PC). Mobile tasks were, in general, simpler and more dependent on a specific mobile context. Three main elements were identified as a basis for cross-platform service user experience: *fit for cross-contextual activities, flow of interactions and content, and perceived service coherence*. [10]

#### Towards a research agenda of cloud UX

Cloud computing paradigm is changing software products to software services. This emphasizes the need to study user experience as Service User Experience [9], taking into account the whole service life-cycle and the different situations in which the users

interact with the service. Service user experience needs to be designed separately for different services, different users and different contexts of use. It is not possible to give a general definition of a superior user experience. However, based on our user experience studies – some of which were introduced in the previous section – we can conclude issues that will need attention in future research. In this section, we will present Cloud UX research questions for main themes which we have identified to be central for successful (efficient and enjoyable) cloud services.

#### *Access to user data*

With Open Telco the users felt that a central digital identity in the form of a universal user profile was more secure and easier to maintain than several separate profiles. However, some users were quite cynical and thought that once information is in the Internet, it sooner or later gets manipulated or misused.

Today many popular consumer services such as Facebook, Flickr and email services are cloud based. However, users still commonly have local copies of their photos and other important documents, so the services are not yet totally cloud-based.

Internet service providers are monitoring user behaviour and collecting lots of user data without the users being aware of what is actually monitored. Cloud facilitates combining different data of the user and that can reveal very sensitive and personal issues of an individual user. Personal data scattered around the world in different servers is a privacy threat.

- How to establish efficient and pleasurable means for creating and maintaining universal user profiles?
- In what ways should the users be supported in storing local copies of their data?
- What are users' perceptions of data ownership and what are the ways to overcome the threats to the user's personal data, including context data?
- How can people foresee how different user data can be combined and what are the possible consequences of that? How can people be protected?

#### *Multi-device access*

Cloud computing gives possibilities to improve user experience by making information and services accessible anywhere and with any device. Cloud gives practically unlimited memory capacity and the users do not have to worry about backups or version updates.

- How should the UIs on different devices be designed so that cloud service users can seamlessly continue their interaction tasks while moving between devices?
- How can the user interface design of a service and the content used on many devices support the user experience of a coherent whole?

#### *Social UX*

Cloud services are often communication and social media services where users interact with each other either directly (e.g. email, messaging) or through media content (e.g. content sharing, social media

commenting). Content creation by user communities is an essential aspect of Web 2.0 services in the cloud.

- How to facilitate social experiences in the cloud? As UX often originates from the content provided by other users and not from the service itself, how could cloud services enhance this sociability?
- What are the requirements and best practices for content and service co-creation in the cloud? How can mashup creation be supported?
- How should contact management be handled in the Cloud: Synchronisation between services, user roles, privacy, etc.?
- How should different social communication profiles be supported, e.g. intimate or always-on communication, ad-hoc communication, etc.?

#### *Reliability, security and trust*

When travelling, Internet connections are available only at some places and they may be quite expensive. In totally cloud-based environment also the applications are located in remote servers or they are using infra or services of a remote server. That is why without a working network connection the user cannot do much. In case of [8], offline use cases were partially supported by pushing some of the shared photo content locally to the user's handset. In a way this breaks the cloud paradigm but may still improve UX.

Users see security as a very important factor when using cloud services. For many people, security of a cloud service is even more important than ease of use or good functioning. User trust towards a cloud service requires ease of use, familiar brand, understandable

licence agreements and professional appearance of the service.

- How should the offline use cases be supported?
- How to present to the user how the data is securely stored?
- What are the access rights management design principles which enhance user's trust?

#### *Pricing principles*

Pay per use can be beneficial to the user if the services are priced moderately. It may be difficult to the user to make sure that the service provider has reliable measures of resource usage in pay per use. A common scenario is paying for service usage by viewing commercial messages. On the other hand, in cloud environment it is extremely easy to change the service provider as people are using rental software instead of applications that they should buy to themselves.

- What are the optimal, and clearest pricing principles for the end users to be able to estimate a "fair" price for a service?

#### *Service discovery and life cycle*

In the cloud, users have potentially a very large set of services from which they can choose. New services enter the cloud and old ones may be discontinued. Users may have problems in knowing how to take new services into use, and possibly integrate or substitute them with the existing ones.

- How can users find the best suited services in the (potentially) large set of cloud services?

- How can users identify new services and take them fluently into use, and integrate them to the user's existing set of services?
- Eventually, how can the user get rid of services, i.e. shut off from the cloud and remove the personal data?

### Conclusions

In this paper we have presented the basic principles of the cloud from end-user's viewpoint as well as several cloud service research cases. Based on that, we have highlighted key "cloud UX" research issues. The key issues in cloud UX are related to user data storage and access, fluent multi-device access of services and content, social UX, reliability and trust, pricing and service discovery and integration.

The cloud paradigm emphasizes service mashups and service entities. Thus UX approach should also be extended from individual services to service entities. Similarly, user data should be studied across services. Most crucial privacy threats are related to integrating user data from several sources.

The cloud paradigm is based on the existence of fast, reliable network connections. Until this is a reality always and everywhere, UX research should take care of ensuring means for users to access services and data even if temporarily disconnected.

While universal UX targets are hard to set, common UX qualities could be defined for the services in a specific domain area. The topics of the research questions will help researchers in setting research goals and service developers in setting domain-specific cloud UX targets.

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