

# User Created Content in the Extended Home

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**Abstract** — User created content, particularly from handheld and mobile devices, is on the increase both in terms of quantity and the quality of sharing and enjoying each others productions. Whether the content is family holiday shots or a semi-professional fan films, the motivation to create and give, and the desire to share each other’s experiences is common place. The PC and mobile based tools, and their on-line cousins are advancing too, to make this practical to users of all capabilities. However, the growth of user content sharing has grown the volume of media and diversity of tools, which in turn leads to usability and user group fragmentation hindrances. This paper presents the user groups, user sharing desires, technical sharing methods and enhanced sharing techniques. In combination this offers the promise to improve and increase user created content sharing in the home, nomadic and extended home environments; and keeps its emphasis on having fun.

**Index Terms**— extended home, user-created content, content sharing

## I. INTRODUCTION

USER-created content is being released to public and private groups at an increasing pace. Improved ease of creation, storage and usage tools are the root of this, as well as the increasing presence of digital creation and authoring tools away from the desktop. For consumer creators, their homes remain the hub of the content administration, editing, publishing and archiving by PC their handheld produced media. However, an increasing quantity of media, its size and its format diversity present a backwards force which retards the sharing of user-created content. Thus, with current tools, sharing of user-created content does not scale well to large quantities of content and the diversity of tools and services.

The available methods to offer user created content for wider user groups, and the issues of combined and mixed methods, are described.

Two areas of improvement are presented. The first involves employing the user’s home as a media portal – or more specifically one or more devices located at their home over which they have administrative and access control. The benefits of simplifying offering share content, controlling the look and feel of how your family, friends and community see your content and aggregating the access point are shown.

The second improvement involves using the home and its devices to enhance both sharing and browsing and retrieval of

content created on the move. The combination of nomadic and at-home user scenarios presents very interesting opportunities for mobile content creation and empowering families and other social groups to share in more natural contexts while retaining the control and power of the home environment.

First, however, it is interesting to look into two important social and technical building blocks for the techniques to be covered: the user groups that sharing implicates; and, the sharing paradigms, or elementary use cases, that users subject their content to.

## II. USER GROUPS

There are four clearly identifiable classes of users that might be granted access to the content that a person has generated and stored in some of the devices he/she possesses.

- **Creator** is the owner of the content and has full access rights to it. They can read, edit, delete, and decide who can access it and how they can access it.
- **Close family members** are the very close members of creator’s family that usually live in the same physical home. Those members usually have full access rights to most of the content, and they are allowed to also add their content in common media albums.
- **Extended family and friends** are people linked to the content creator. Typically they do not live in the same home as the creator, but they would be welcome to physically visit, which means that they are somewhat trusted people. The same trust applies to the content that they can access, with read access rights to specific media albums, and maybe the ability to add content in albums that were created for common experiences and events.
- **Community** is a much wider group of people which share some common interests with the content creator, but are not normally known to him/her. For example, people with the same hobby that would like to exchange related images and videos. Since there is no direct relation with these people, they would not be trusted with valuable content and thus they would have only read access rights to very specific content albums, and perhaps explicitly stated copyright terms.

## III. SHARING PARADIGMS

There are four main, user methods of sharing content [19]:

### A. Showing

“Showing” is to display content items face-to-face (or remotely) without transferring the content from the original device. In case of showing something face-to-face, people

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would view the content, for example pictures, on a device controlled by the owner, such as mobile phone or TV. In the remote context, which means that the recipient is not visible out of one's eyesight; the session is established via a See-What-I-See service, such as 3G video call or PC desktop sharing application, like Microsoft Live Meeting [2].

Major characteristic of this paradigm is that the recipient does not need to have a special device being able to render the specific content/media type, since it is rendered in the device of the owner and just displayed to the recipient's device. Showing content requires person-to-person real-time interaction, so it is mostly used for sessions among family and friends.

### B. Sending

In the "Sending" case, the media items to be shared are transferred remotely to the recipient. Either the original media file or a copy of it. Such cases are the sending of an e-mail with an image attachment or sending a Multimedia Messaging Service (MMS) message between two mobile phones.

People are very well practiced in this sending mode, mainly as Internet e-mail has been the dominant method of digital content sharing for many years. As in the previous case, sending is also mainly used for person-to-person communication because previous knowledge of the recipient is required, before sending any content.

### C. Giving

"Giving" refers to the physical/face-to-face hand over of media items. Either original items or copies of them are transferred from the sender to the recipient device. It mainly applies to wireless proximity based sharing, where a near-field communication technology (such as Bluetooth) is used for exchanging content between devices in physical proximity. Giving physical media follows this method too.

The face-to-face aspect of this method sets a basic requirement on the interaction of people in proximity, that most probably know each other, and thus there is a relation of trust.

### D. Offering

"Offering" is to make items available face-to-face or remotely, for others. Items are not transferred unless downloaded by the other party, and only a copy can be taken. Examples include offering of pictures on a website, or offering music files via peer-to-peer networks in the remote case. In first case, hosting space can be on a 3<sup>rd</sup> party server, while in the second case it is directly offered from one of the owner's devices. Moreover, the Nokia Sensor [4] application is an implementation example of proximity based offering. The actions of offering, by the owner, and downloading, by the recipient, are asynchronous and require no personal pre-knowledge of the two parties.

## IV. OFFERING OF USER CREATED CONTENT

The offering paradigm is probably the most widely used way to share in the web, because it can be executed in non-real time environment. The creator can choose when to upload content and invite visitors, who can then access it if and when

they want. Moreover, sharing via offering scales from small numbers of friends to large community groups. Thus, it is interesting to analyze in more detail the different ways of content offering, their advantages and disadvantages.

### A. Local Home Network Connectivity

When friends and family members physically visit the house of the content owner they can use their personal devices to get link connectivity to the Wireless LAN of the house, if the owner provides to them the required settings and security keys. After that they have full network access to the home network, and they can use a compatible client to access the content as the owner of the home would do. For example use a Universal Plug-n-Play (UPnP) [5] Audio/Video (AV) control point to browse the content of a compatible UPnP / DLNA [6] media server. There are currently some important issues in this scenario:

- Distribution of network and security settings: In order to allow a visiting device to access the wireless home network, a few parameters, such as network name, security keys etc., need to be passed along to the device. A few proprietary solutions already exist, for making easy the transfer of those settings, but also the Wi-Fi Alliance [7] is currently working for standardizing such a solution.
- Removing network access rights: Once the visitor has exited the home, there might be need to remove the previously given access rights. In that case, the security association between the home and the visitor device should expire after some time or action by the home owner.
- Specific device access and control: When providing network level access to a visitor all home devices are exposed, unless there is a mechanism to allow access only to specific devices. For example, only to content servers and not to other critical home equipment. UPnP deals with these problems, via the device security [8] concept.
- Specific content access: Once the visitor is granted access to a media server containing content, he/she should have access only to specific albums, according to the preferences of the owner.

### B. Remote Home Network Connectivity

In this case a visitor is granted network connectivity access to the home network, but remotely. Usually done via Virtual Private Network (VPN) techniques for establishing a secure tunnel between the visitor's device and the owner's home network. As in the previous case, the network layer access is very powerful, since the visitor's device is connected to the network as it would be with a physical connection within the home. So, almost the same security and access rights issues apply here, but the remote aspect offers visitors this kind of connectivity wherever they are and so requires more trust than for physical visitors.

### C. Remote Connectivity to Specific Media Servers

If direct access is available from the public Internet to the individual home devices, for example if they have public IP

addresses, visitors can access a specific media server located at home and, after providing the required credentials, can get access to its content.

In cases that there is no direct access, for instance if only one public IP address is available and all home devices are behind a Network Address Translator (NAT), there is the alternative of using Application Layer Gateways, such as HTTP proxies. They can be used in the home gateway for allowing specific access to some of the devices and applications running on a home server, assuming that the home gateway can be addressed and accessed from the public Internet. For example, allowing visits to a web server located in the home, hosting web pages with image and video albums.

The access rights, given to each visitor, are controlled by the application controlling and presenting the content, i.e. a web server. The content is securely hosted and controlled by the devices of the owner. Thus from privacy point of view it is very suitable for personal content. However, the problem is that it cannot scale to large numbers of visitors, since it would make extensive usage of the home Internet connection. So, this solution is best up to the extended family and friends groups as the visitors to the content.

#### D. 3<sup>rd</sup> Party Access Providers

Addressing and accessing of home devices is not always guaranteed, since there are cases that the Internet Service Providers (ISP) are using NATs and provide only private IP addresses to their customers, or use firewalls that do not allow incoming connections for security reasons. In those cases, simple Application Layer Gateways cannot exist in the home network and there is need for a 3<sup>rd</sup> Party Access Provider to tunnel the traffic from the public Internet to the home device. Many such services exist, and many of them are optimized for content sharing from Microsoft Windows based PCs, such as Orb [9] and the DivX project Neon [10]. Even though the content is permanently stored in the owner's devices, it is tunneled and delivered to the visitors via 3<sup>rd</sup> party servers (i.e. in Orb) or peers (i.e. in project Neon). Thus availability and privacy heavily depends on the continued trusted operation (and business) of the service provider. An interesting technical aspect of this approach is that primarily just the discovery and reachability functions are essential. Hence, both the professional service providers (e.g. Orb) and the community base "infrastructureless" peer-to-peer (e.g. DivX Neon) systems are suited to the task.

#### E. 3<sup>rd</sup> Party Content Sharing and Hosting Services

This includes Internet photo sharing services, such as the very popular Flickr [11] and weblogs. The user uploads the content to a 3<sup>rd</sup> party server and invites visitors to access it from there, once access rights to albums have been configured. The obvious advantage is that the visitor access to those services does not interfere with the bandwidth and the Internet connection of the home network. However, there are important privacy issues since the content is handled by a 3<sup>rd</sup> party service operator. For example, the user can never be sure if the content is really deleted, or still archived somewhere, when he/she instructs the service to erase it. It is up to the individual user to decide how trustworthy the service operator

is, and if his/her personal content can be shared with such a method.

#### F. Current reality

Since all the described methods have both advantages and disadvantages, we cannot clearly pick up one perfect solution for all cases. For example, local & remote home connectivity is mainly used for accessing the content by the owner and the close family members. Application layer gateways and 3<sup>rd</sup> party access providers are used for sharing content with family and extended friends, while the 3<sup>rd</sup> party content sharing and hosting services are used for sharing with wider groups of friends and the community. Currently, some users use many solutions concurrently, for matching their needs, where as most users use just one easiest-to-understand approach.

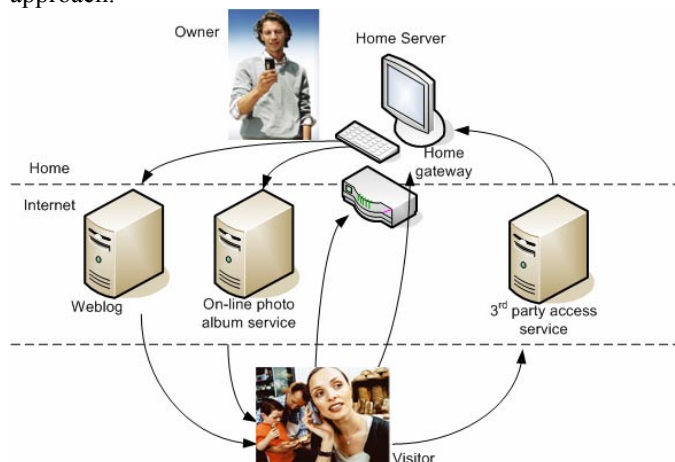


Figure 1. Current plethora of content offering methods

### V. THE HOME AS A MEDIA PORTAL

The different content sharing methods in and outside home, can supplement each other in a wider sharing framework in which the home can be the centre of user-created content sharing.

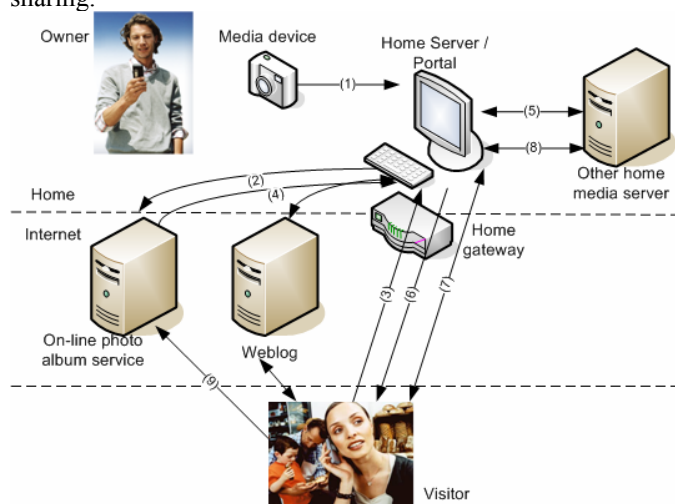


Figure 2. The home service as a media portal

All personal devices and 3<sup>rd</sup> party services can merge via a home portal that would provide a common gateway to all



notifies the “Home Proxy” that a new post exists. It uploads only the essential information of the post (for example the text summary and the metadata of the image), but does not actually transfer the large, high quality, binary image file to the server. Instead, it provides a link to the actual content.

3. The server updates its database and its web pages, so that the new post is instantly available for any visitor.
4. A visitor requests the web page that contains the specific post.
5. The server provides the latest post, as well as a virtual HTTP link, pointing to a virtual image file (on the “Home Proxy”), supposed to contain the binary image item of the post.
6. If the visitor’s client decides to retrieve the binary item, there is an HTTP GET request made to the “Home Proxy”, for the specific content item.
7. The server then contacts the mobile terminal, and requests the actual binary file, over GPRS. We can assume, for example, that the mobile phone runs a light web server, and thus it can accept such requests.
8. The mobile terminal returns the file to the “Home Proxy”.
9. The “Home Proxy” then sends the file to the visitor, as a response to the request made in step 6. So, the visitor gets the full post, including the binary item, without noticing that it was actually retrieved on-the-fly from the mobile terminal.
10. The home proxy keeps a copy of the file on the “Storage” database.
11. If another visitor (“Visitor 2”) is later on requesting the same file, the server does not need to retrieve it from the mobile terminal again. It is directly retrieving it from its storage database.
12. And returning it to “Visitor 2”, as a result of the request made at step 11. This also eliminates the possibility of a repeat attack on the mobile terminal from other end-hosts as the “Home Proxy” ensures that direct retrieval occurs a maximum of one time per item.

If we assume that the audience of the content created and shared directly from the mobile phone is relatively small, e.g. close family members, there is a good chance that no visitor requests the content until a reasonable period of time after the moment that the content was uploaded (using the mobile device) to an Internet server. Hence, immediate upload may not offer any significant value in many cases. This is the reason why the content is not directly uploaded to the home proxy, but only its metadata is, in step 2. By the time the first visitor requests the specific content, the mobile device may have moved past or to a location where a more attractive network connection is available – such as free short range Internet connectivity, e.g. WiFi. In this case, the higher cost for transfer of high quality images over the GPRS network would have been unnecessary, since it could have happened later via the more attractive network option [18].

## VII. CONCLUSION

The home offers both familiar activities to users and capable technologies at their disposal. We have shown two methods to improve both home and extended home content sharing, particularly of relevance to families, friends and communities. This leverages the explosion of both mobile content creation and PC-based content creation.

Several aspects remain for further development and testing of both technology and user perceptions. The paradigm of a single user (owner) producing, maybe editing and publishing content has been good enough to generate the explosion sharing on the Internet. However, joint ownership and family experiences, mutual building of communities and the social binding between friends all indicate that a single ownership model is insufficient for social and home-based sharing. Further exploration is needed into going beyond today’s norm of the current “single family technical administrator”.

Similarly federations of homes, in addition to groups of users, offer much more complex inter-relations of content; especially when post edited as published collections/albums often are. Binding homes by network, devices, services and content – more than simply remote mobile access to a single home – includes many usability and security challenges.

User-created content sharing promises to offer many more fun experiences and excellent technical challenges into the future. In the home, mobile and extended home cases, this area promises to be exciting for the foreseeable future.

## REFERENCES

- [1] J.S. Olson, J. Grudin, and E. Horvitz, “A Study of Preferences for Sharing and Privacy”, Ext. Abstracts of CHI '05, ACM Press (2005), 1985-1988.
- [2] Microsoft, Live Meeting [Online]. Available: <http://www.microsoft.com/livemeeting>
- [3] Nokia, Nokia Lifeblog . Available: <http://www.nokia.com/lifeblog>
- [4] Nokia, Nokia Sensor [Online]. Available: <http://www.nokia.com/sensor>
- [5] UPnP Forum [Online]. Available: <http://www.upnp.org>
- [6] Digital Living Network Alliance (DLNA) [Online]. Available: <http://www.dlna.org>
- [7] Wi-Fi Alliance [Online]. Available: <http://www.wi-fi.org>
- [8] UPnP Forum, Device Security and Security Console V 1.0 [Online]. Available: <http://www.upnp.org/standardizeddcpss/security.asp>
- [9] Orb Networks Inc [Online]. Available: <http://www.orb.com>
- [10] DivX Inc, Project Neon Available: <http://www.projectneon.divx.com>
- [11] Yahoo! Inc, Flickr [Online]. Available: <http://www.flickr.com>
- [12] Strategy Analytics, “Taking Camera Phones into Digital Still Camera Territory: Megapixels, WLAN and Printers”, April 2005.
- [13] Yahoo! Inc, Yahoo! Go [Online]. Available: <http://go.yahoo.com>
- [14] M. Nottingham, R. Sayre, “The Atom Syndication Format” IETF, RFC 4287, December 2005. Available: <http://www.ietf.org/rfc/rfc4287>
- [15] D. Libby, “RSS 0.91 Spec, revision 3”, July 10, 1999. Available: <http://my.netscape.com/publish/formats/rss-spec-0.91.html>
- [16] R. Venkateswaran, “Virtual private networks”, IEEE Potentials, Volume 20, Issue 1, Feb-Mar 2001 Page(s):11 – 15
- [17] L. Brinkhoff, “HTTP tunnel” [Online]. Available: <http://www.nocrew.org/software/httpunnel.html>.
- [18] P. Belimpasakis, R. Walsh, “A Resource-efficient Mobile Blogging System”, accepted for presentation in “6th International Workshop on Applications and Services in Wireless Networks”, Berlin, Germany, May 29-31, 2006.
- [19] R. Grignani, Y. Jung, A. Kaikkonen, “D1 Sharing paradigm”, Unpublished