User-Generated Content: The Case for Mobile Services

Christian S. Jensen, Carmen Ruiz Vicente, and Rico Wind
Aalborg University

Enabling user-generated services could help fuel the mobile revolution.

Websites that enable the sharing of user-generated content such as photos and videos are immensely popular, and their use is on the rise. Currently 30 million photos are uploaded daily on Facebook, a figure that has been growing steadily (www.facebook.com/press/info.php?statistics). According to Kansas State University's Michael Wesch, users uploaded 150,000 to 200,000 videos on YouTube in early 2008, up from 65,000 during summer 2006.

Technologies that enable websites to support the creation, sharing, and deployment of user-generated mobile services could be key factors in the spread of the mobile Internet.

While a mobile service can be just about anything, our focus is on geospatial and social services. The former kind of service utilizes available geopositioning capabilities such as the Global Positioning System, while the latter involves users' social networks.

For example, one service could alert its users when they are near a friend. Another service could enable a user to leave virtual Post-its, photos, or videos for friends to discover as they get near them. Yet another service could let users publish their vacation travel experiences in real time for family, friends, and the general public to react to, by continually uploading georeferenced content. The possibilities are virtually limitless.

EASE OF SERVICE CREATION

All that is required to contribute photos or videos to an online service is a camera or camcorder and basic computer skills. A first challenge in enabling user-generated mobile services is making it equally easy for ordinary Internet users to create such services.

In particular, mobile service creation should not be limited to professional computer programmers, who constitute a fraction of the world's population. Rather, all those who can contribute to Facebook and YouTube should be able to create mobile services. One way to accomplish this is to enable programmers to create "service templates" that nonprogrammers can fill in to configure and create services.

SERVICE FUNCTIONALITY

A mobile service creation platform should offer easy-to-use functionality for creating compelling geosocial services. It should support basic aspects of services such as authentication, security, and privacy as well as the ability to flexibly push content to users.

Examples of advanced functionality include the ability to track the locations of other users with varying accuracy and the ability to capture users' own past movements and then make them available to services. For example, a service could automatically predict a driver's route, suggest locations where inexpensive gas is available along the way, and inform the driver of parking options at the destination.

SERVICE SHARING

A successful ecosystem for user-generated mobile services includes the ability to share services. Creators of services must be able to advertise them to other users who can then subscribe. This calls for some kind of service directory, but it might also benefit from rating, reviewing, and recommendation schemes that enable viral advertising.

SERVICE DEPLOYMENT

A user is home free after uploading content to a photo- or video-sharing website, which takes care of rendering the content. However, things are more complicated for services.

A mobile service, whether created using a template or as a standalone service, involves functionality enabled by calls to services offered by the service platform, but it also involves other types of functionality. Which computer that additional

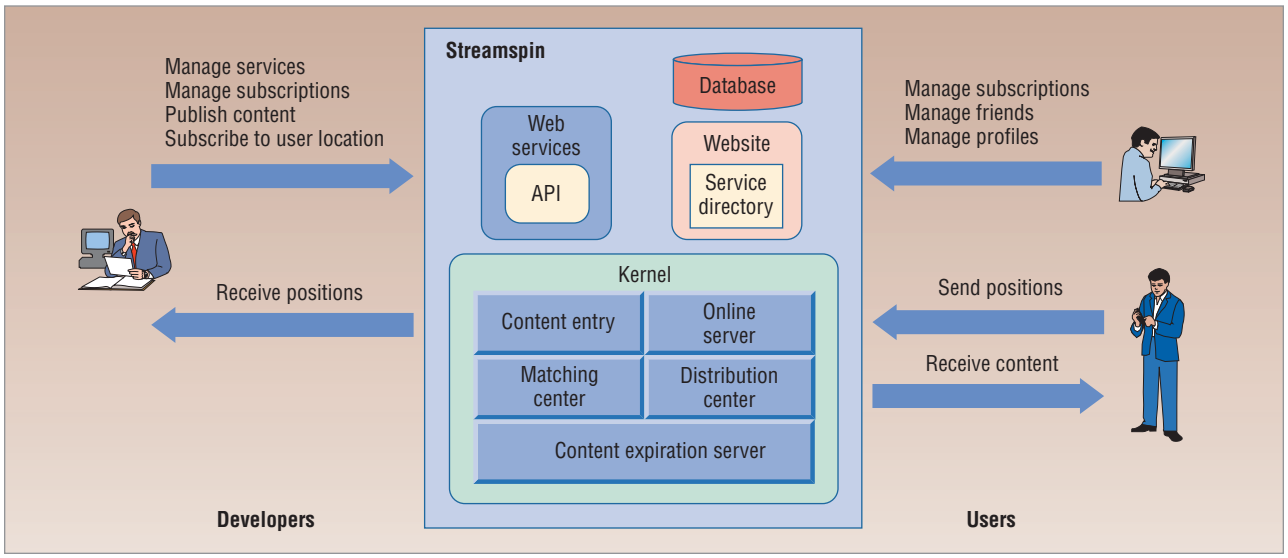

Figure 1. Streamspin architecture. The system provides functionality for both service developers and users.

functionality should run on must be determined, which raises the question of what the architecture of a service deployment system should look like.

We believe that a mobile service deployment system should be scalable and open, and that it should create value for its owner and everyone else in the ecosystem.

Specifically, the system should scale to large numbers of service subscriptions. This can be achieved by an architecture of loosely coupled components that replicate across different physical computers, thereby enabling parallel processing.

The need for an open system is perhaps less clear. We regard an open system as one that offers a large degree of freedom in using its functionality, in part or full, and in combining this with other available functionality. We believe that this kind of openness is important in making the platform attractive to service developers.

Finally, a mobile service deployment system should enable a synergistic ecosystem that benefits all involved. One aspect of this is to ensure that the service platform itself creates value for its owner. Another is to guarantee that service developers are rewarded for their efforts. If the ecosystem is fueled by advertising revenues, users who create successful services must be rewarded proportionally.

STREAMSPIN

At Aalborg University's Center for Data-Intensive Systems (http://daisy.aau.dk), we are exploring technologies that will help build websites that support user-generated mobile services. The "Further Reading" sidebar highlights some of the center's research in this area.

We have made a prototype system called Streamspin (http://streamspin.com) available to external users. As Figure 1 shows, the system's functionality targets service developers and users.

Users subscribe to, and receive content from, a range of services through a single interface. They access the system through both the Streamspin website and a mobile client. On the website, users can register, enter their profiles, find friends, and subscribe to and set up services available in the service directory. On the mobile client, users receive content—including text, HTML, images, music, and video—from the services they subscribe to.

Streamspin lets developers create and publish services that deliver content to subscribers. To support service development, the system encapsulates low-level communication functionality in Web services, effectively enabling access to the functionality from most platforms and programming environments. Streamspin also encapsulates the functionality in a range of programming APIs, thereby hiding details such as message signing (for security reasons) and network failures.

Developers can create customized services that are ready for subscription as well as service templates that let users instantiate a certain type of customized service by simply filling in a form. Anyone capable of banking online should be able to create services.

For example, users can create their own mobile tour service and subsequently make it available to their friends or the general public. A user fills in a template with some general information and enters a set of *points of interest* consisting of a

- photo, found on the user's hard disk; a
- piece of text, entered into a text field; and a
- location, obtained by clicking on a map.

The resulting service pushes a point of interest to a subscriber when the subscriber gets close to it.

Further Reading

The following articles provide additional insight into user-generated mobile services.

- A. Brilingaite, C.S. Jensen, and N. Zokaite, "Enabling Routes as Context in Mobile Services," *Proc. 12th Ann. ACM Int'l Workshop Geographic Information Systems* (GIS 04), ACM Press, 2004, pp. 127-136.
- C.S. Jensen and S. Pakalnis, "TRAX: Real-World Tracking of Moving Objects," *Proc. 33rd Int'l Conf. Very Large Data Bases* (VLDB 07), VLDB Endowment, 2007, pp. 1362-1365.
- R. Wind et al., "A Testbed for the Exploration of Novel Concepts in Mobile Service Delivery," *Proc. 8th Int'l Conf. Mobile Data Management* (MDM 07), IEEE Press, 2007, pp. 218-220.

A piece of content consists of a *header*, which is simply a line of text, and the *body*, which can be text, HTML, or a URL. When Streamspin pushes a piece of content to a user, the user's mobile device displays the header. If the user clicks on the header, a browser displays the body. If the body is a URL, the client automatically downloads and displays the content. This means that the content can be of any type supported by the mobile client: HTML, video, images, music, documents, and so on.

GEOSPATIAL SERVICES

The Streamspin API lets service developers track subscribers by means of a single method call. The developer supplies the user ID, the requested tracking threshold, and a callback URL. When the user exceeds the threshold, the system makes a callback to the URL that includes the user's ID and the new location.

We have developed simple services that push entries from RSS feeds, blog entries, and e-mails to subscribers as they become available. These services are template services that users set up to meet their own needs. For example, users must supply login information for a Post Office Protocol 3 server to receive new e-mails on their mobile device.

The Streamspin team has also created several location-aware services, including the aforementioned tour service and a service that pushes a user's shopping list to the mobile device when the user is near any of a number of predefined shopping locations.

In addition, we plan to make available a function capable of predicting a user's route and destination based on the user's past travel as known to the system. We also are implementing a new approach that will seamlessly integrate indoor and outdoor positioning to enable tracking of users across these environments.

SOCIAL NETWORK SERVICES

Many people rely heavily on their online social networks, and we are developing several services that combine geospatial functionality with social network awareness. For example, Streamspin will include functionality that lets users transfer friends and contacts to and from social sites, and the system will aim to integrate with such sites.

We will also add privacy support to the system. Users will be able to select the content that they want to make available to other users or services. For instance, users might not want to be tracked by some services in certain situations, or they might wish to restrict certain published content to certain friends.

In addition, incorporating a user's social networks into Streamspin will enable advanced recommendations based on the opinions of more relevant users such as friends and those with similar interests.

As the mobile Internet continues to emerge, increasing numbers of services will embody geospatial and social functionality. Researchers should focus on empowering service users, programmers and nonprogrammers alike, to create and share mobile services. This will enable the kind of bottom-up creativity on the mobile Internet that has served the conventional Internet so well.

Christian S. Jensen *is a professor in the Computer Science Department and director of the Center for Data-Intensive Systems at Aalborg University, Denmark. He is currently on a sabbatical leave at Google. Contact him at csj@cs.aau.dk.*

Carmen Ruiz Vicente *is a PhD candidate in the Computer Science Department at Aalborg University. Contact her at carmrui@cs.aau.dk.*

Rico Wind *is a PhD candidate in the Computer Science Department at Aalborg University. Contact him at rw@cs.aau.dk.*

Editor: Bill N. Schilit, Google; schilit@computer.org