



# Works in Progress

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## Integrating User-Generated Content and Pervasive Communications

### EDITOR'S INTRO

This month's Works in Progress department features eight projects that support the integration of user-generated content (UGC) in a world of pervasive communications. The projects range from AI-based UGC service discovery in the first essay to a semantically enriched information model that communication systems can use to deploy UGC in pervasive applications in the last essay. Between these two, you'll find six different, innovative approaches to advancing this highly individualistic, yet finally communal information resource.

—Anthony D. Joseph

### INTELLIGENT MATCHING FOR DYNAMIC SERVICE DISCOVERY

*Carlos Baladrón, Javier Aguiar, and Belén Carro, University of Valladolid Antonio Sánchez-Esguevillas, Telefónica I+D*

User-generated services (UGSs) are the next step in the user-generated content (UGC) trend. UGSs let end users create their own personalized services using simple graphical tools, such as Microsoft Popfly or Yahoo Pipes.

In the dynamic UGC environment in general, and UGSs in particular, content producers add new items at high rates. This makes the discovery process a key system life-cycle step, letting end users find the specific items suited to their needs. Traditional categorization and browsing based on tags, and even semantics, also work for services, but they can be tedious and tend to depend on how users identify and express their needs. These tasks become more difficult when trying to find services.

Our work aims to design a system to automate the requirement identification and service discovery task for UGSs. The system will analyze context, user profile, and user history to find suitable services,

combining semantic characterization and metrics with AI and pattern-recognition algorithms, such as neural networks, to identify user requirements in real time and match them with existing services. For example, when users aren't in their home town, the system offers a GPS mapping service when they enter their cars.

Our research team will test and validate the proposed system via the UGS's OPUCE (Open Platform for User-Centric Service Creation and Execution) project platform, which is part of the EC's Sixth Framework Program for Information Society Technologies.

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### WIKIVIENNA: COMMUNITY-BASED CITY RECONSTRUCTION

*Matthias Baldauf and Peter Fröhlich, Telecommunications Research Center, Vienna Przemyslaw Musialski, VRVis Research Center, Vienna*

The Austrian research project WikiVienna takes today's Web phenomenon of end-user content generation to the next level by collabora-

tively reconstructing an urban environment through user-submitted photos. WikiVienna aims to complement ambitious large-scale geospatial modeling efforts, such as Google Earth, by letting users add details and refine a 3D city model in real time using their mobile phone cameras (see Figure 1).

In contrast to previous end-user modeling solutions, such as Google's 3D drawing software SketchUp, WikiVienna relies on spontaneous contributions. A small application for mobile phones lets participants shoot photos, add text and audio annotations, and upload them to WikiVienna's reconstruction server.

WikiVienna represents a strong collaboration between visualization and telecommunications research. The server-side algorithms create the model by extracting unique feature points from the images to generate a cloud of three-space points as input for reconstructing building facades. One challenge here is to provide optimized reconstruction results despite the often limited quality of phone cameras.

From the telecommunications perspective, we investigate how to make the created model and its information space accessible through mobile phones. This involves investigating novel ways of visualizing georeferenced content. The project develops mobile visualization methods that range from remote on-demand panorama images of the user's surroundings (see Figure 2) to client-rendered real-time 3D representations.

For more information, visit [www.wikiVienna.at](http://www.wikiVienna.at).

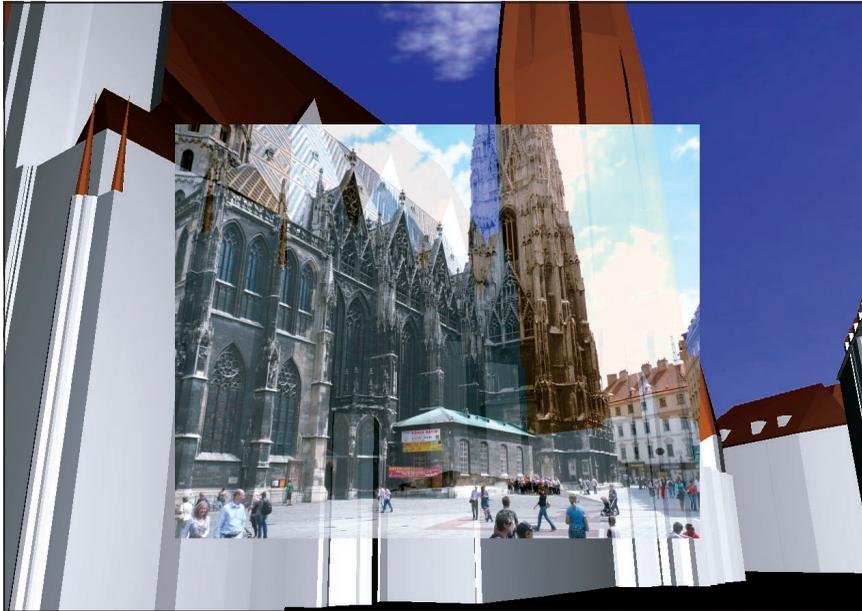


Figure 1. Mapped photo of St. Stephen's Cathedral. Using extracted feature points, WikiVienna automatically maps a user-submitted photo of Vienna's most famous cathedral to its position in the server-side 3D model, which helps refine the model.

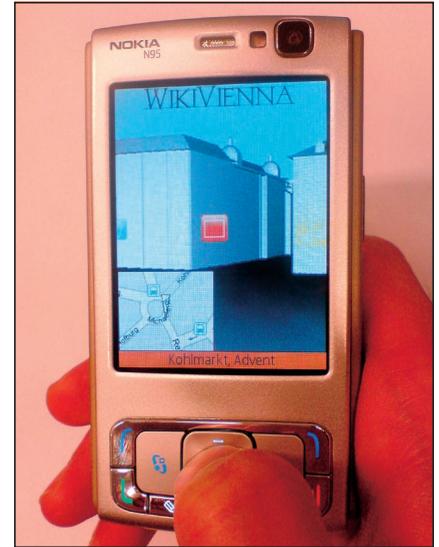


Figure 2. Model visualization in a city-exploration tool. Remotely rendered panoramic images of the user's location are augmented on a mobile phone with points of interest.

## LEVERAGING CONTEXT FOR SOCIAL MEDIA MOBILE SERVICES

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User-generated content is an important market driver for Web 2.0 IT players. We apply this paradigm to the mobile telecom world, combining user-generated content with users' context data to create innovative services.

In an e-tourism application, mobile users can upload pictures to an e-tourism server with their camera phones. A context agent (CA) running on the mobile phone sends updates to a context-aware platform. While this platform filters context data to enrich the mobile content for Web publication, a contextual-tagging module automatically adds context tags to the content. These tags let users filter and browse pictures and videos according to different context parameters.

Our application generates context tags using specific namespaces such as *address* and *people*. It also uses widely popular location namespaces, such as *place*. For instance, *place:is=crowded* is added to pictures taken when the user is surrounded by many Bluetooth devices. For example, the e-tourism system could show only the pictures taken in a specific place, when one or more users are nearby. Users can browse machine-tagged patterns and video as tag-based collections, filtering by namespace, predicate, or value.

Users could syndicate dynamic picture collections to the e-tourism mobile service prototype through RSS feeds. For example, they can retrieve pictures of nearby landmarks from their mobile phones. Moreover, multimedia feeds can enrich the automatically generated description of the users' day, published as a blog post.

In the Telecom Italia Lab, we developed a system that we've been testing for almost two years, hosting nearly 160 platform users. So far, the system has automatically published more than 11,000 machine-tagged pictures and videos.

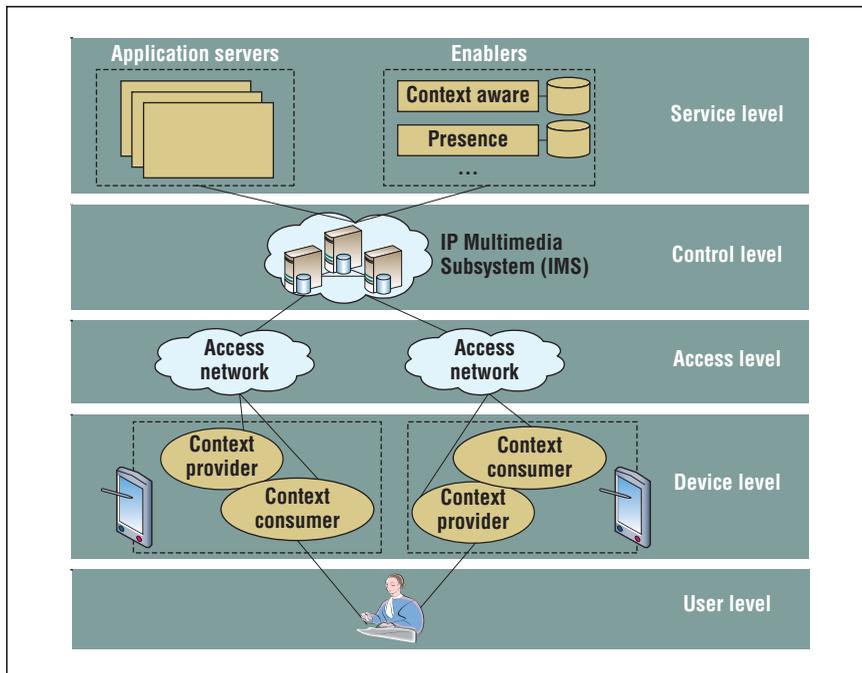
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## USER-GENERATED CONTEXTUAL INFORMATION FOR HORIZONTAL NETWORK SERVICES CONVERGENCE

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Most context-aware architectures depend on vertical context-aware service platforms and ad hoc sensor networks. In ongoing work, we propose a global architecture that enriches service-layer applications hosted on the operator network by adding user-generated contextual information to them.

A convergent-control layer based on the 3GPP (3rd Generation Partnership Project) IP Multimedia Subsystem (IMS) specification provides network-agnostic connectivity to contextual agents that run on end-user mobile devices, domotic systems, and so on. The agents capture context information that's transmitted through the IMS to



**Figure 3. Architecture for horizontal network-services convergence. The IMS control layer provides network-agnostic connectivity to contextual agents.**

the Horizontal Hosted Service Layer, where different service entities or application servers can share information (see Figure 3). Contextual processing is centralized in a Context Enabler that receives all contextual stimuli and processes it for a single user. Contextual inferences will become more accurate as the number of context providers increases. Because the architecture supports all types of inputs, the number of providers can be very large.

After the Service-Layer Enabler infers a user's context, the Context Enabler can notify any application (both legacy telco service or next-generation application server) of such an event if it's relevant for the service itself.

We're currently defining the IMS-layer impacts, designing the Context Enabler, and specifying a contextual protocol that might use the Session Initiation Protocol as transport to connect the different contextual agents. We're also building a demonstrator to verify the architectural proposal.

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### ASINFOTOUR: SERVICE APPLICATION SUPPORT FOR TOURISM AS A SOCIAL ACTIVITY

*Federica Paganelli, David Parlanti, and Dino Giuli, National Interuniversity Consortium for Telecommunication*

**A**sinfoTour is an ongoing applied research project focused on design and development of a mobile tourist-service application. It's funded by the Italian Ministry for Research with participation by the Italian National Interuniversity Consortium for Telecommunications (CNIT) and other IT companies.

AsinfoTour's main contributions to the state of the art are its explicit consideration of tourism as a social activity and its seamless content-and-services integration of external and heterogeneous providers. AsinfoTour is a gateway that lets users access updated content and georeferenced digital services. At the same time, it's a provider of social networking activities among tourists sharing a geographical location. Tourists can

give feedback on services they've experienced and exchange comments directly with other tourists on site. AsinfoTour offers content and services by authoritative providers (such as a telecommunication operator and a tourist information center) and by tourists as well.

We've based the ongoing design and development of the server-side AsinfoTour prototype on service-oriented architecture (SOA) principles. Implementation is based on a middleware for semantics-driven integration of heterogeneous systems. We've built over a service bus compliant with Sun's Java Business Integration specification, and we are enhancing this bus with a special knowledge-base module for semantic service integration. Our approach aims at easing integration among heterogeneous systems, thus allowing innovative mobile applications in the e-tourism context. We also use Semantic Web technologies for managing context information and tagging tourist content and services.

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### PERVASIVE USER-GENERATED CONTENT? WATCH TV

*Maria da Graça Pimentel and Renan Cattelan, Universidade de São Paulo Erick Melo and Cesar Teixeira, Universidade Federal de São Carlos*

**M**any people enjoy watching TV and feel comfortable with the interactions it requires. We propose capturing the remote-control interactions viewers engage in while watching TV and processing the captured information along with contextual information, such as program name and type, interaction time, and location and author identifiers. We could then treat the processed information as annotations on the original media. In other words, viewers would pervasively generate program annotations simply by using their remote controls. Considering the millions of TV viewers, knowing when

users mute the volume or change channels, for example, is invaluable information to TV production teams. They could mine the captured data to identify user behaviors that would help direct program development itself.

We've built a prototype for the Brazilian Interactive Digital TV platform that captures users' remote-control interactions. Different versions of the prototype run on a set-top box with a standard remote control and on a tablet PC that supports both pen- and voice-based interactions. (For more information, see M. Pimentel et al., "Ubiquitous Interactive Video Editing via Multimodal Annotations," *Proc. European Interactive TV Conf. [EuroITV 08]*, LNCS 5866, Springer, 2008, pp. 72–81.)

Our current efforts integrate our capture infrastructure to a peer-to-peer platform (see R. Cattelan et al., "Watch-and-Comment as a Paradigm toward Ubiquitous Interactive Video Editing," (to be published in *ACM Trans. Multimedia Computing, Communications, and Applications*, vol. 4, no. 4, 2008)). The aim is to facilitate the synchronous collaborative sharing of explicit annotations by exporting them to a distributed storage, where mining, linking, and recommendation services can use them. Our plans include evaluating our approach with a broad user population.

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### MULTISERVICE AREAS: INFORMATION MANAGEMENT TO IMPROVE SERVICE PROVISIONING

*Claudia Raibulet, Università degli Studi di Milano-Bicocca*

*Luigi Ubezio and Enrico Valle, ET.S Enterprise Technologies*

**M**ultiservice areas such as fitness centers, shopping malls, multiplex cinemas, and museums are changing how businesses operate. Two opposite business trends lead this development:

- *Unification* regarding geographical location. Providers offering different service types can operate in a common location to take advantage of an already established, known business area.
- *Division* regarding service types. Providers offering different services in the same area can manage their own services independently of the others.

We propose an information-management solution that's also characterized by unification and division. *Domain entities*, such as customers, access rights, and area organization, are unified because customers commonly choose two or more services in the same multiservice area and providers can discount service packages. *Applications* that exploit this information are independent of each other and manage the common information on the basis of their particular objectives and requirements.

In our solution, an access-control framework manages information related to a multiservice area, such as when and where customers enter or leave an area. Users generate this information dynamically, and individual applications use it to perform statistical analysis. For example, an application might use the number of customers exploiting a service inside a certain area and time interval, the most-used access points for an area, the customers remaining in an area to benefit from a service type, or the services attracting customers and filling areas with more people than their regular capacity. Providers can exploit this information to maintain and improve the services they offer.

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### USERS AS GENERATORS OF INTELLIGENT CONTENT

*Martín Serrano, Mícheál Ó Foghlú, and John Strassner, Waterford Institute of Technology*

**P**eople can freely move just about anywhere. Information and communications systems can benefit from this freedom by incorporating information from users' surroundings to offer seamless mobility and facilitate services and network provisioning tasks. For example, they could personalize, deploy, and execute services automatically. Such scenarios require full content integration from sensors, systems, and networks. Current IT and communications research focuses on integrated management that employs users' intelligent content to control resources, networks, systems, and services. The user content can then facilitate service and network management operations.

Our work focuses on semantically enriching the information described in the Directory-Enabled Networks information model (DEN-ng) and thus enabling the use of business and data models for managing communication services. We use ontological data to establish an extensible, reusable, semantic-relationships plane to support management architectural layers that provide tools to integrate user data with management service operations. The semantic plane also supports high-level concept descriptions for understanding user content and thus facilitating more inclusive resource and service governance.

We use ontologies as the mechanism for generating a formal description of users' content, devices, resources, and networks (DENON\_ng). The formal description endows the DEN-ng with the semantic richness and formalism to represent the different information types that network-management operations must integrate to support interoperability and extensibility in the communication systems, which in turn handle end-user contents and deploy pervasive applications.

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