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PIM for Mobility

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ABSTRACT
Most office workers today use multiple channels of communication, including email, cell and desk phones, instant messaging and SMS/MMS. They send and receive large volumes of information through these channels. Only some of this information requires urgent action. While there are many channels to send and receive information, the availability of these channels changes depending on the user's context. User context includes the activity they are involved in (meetings, classes, conferences etc), the date, time, and location, the devices they have access to (smart phones, cell phone, laptops etc), and the mode in which the devices are available (muted or not). For mobile workers, their context plays a key role in keeping them in touch with urgent information.

General Terms
Management, Performance, Design, Reliability, Experimentation, Human Factors,

Keywords
PIM, Mobility, Handheld Devices, Alerts, Information Value.

1. INTRODUCTION
Most of us today have multiple modalities to connect to the e-world. These include multiple email accounts (office and personal), multiple landline phones (office, home and home-office), typically one cell phone, and chat and VoIP accounts. We typically use all of these channels everyday to send and receive information to do our work and to keep our social and family life going.

The availability of these channels changes with our situation during the day. For example, when we are in a meeting our office desk phone may not be available, and when we are away from office our chat may not be available. In addition, depending upon our context, some of these may be in a muted or limited mode. When we remember to, we put our cell phone in a "manner" or silent mode during meetings.

The abundance of communication channels and ease with which information can be sent has led to information glut [1]. We receive large volumes of information everyday and have to devote our time, energy and attention dealing with this volume. When time and attention to process this information are in short supply, for example, when we are in meetings, we run the risk of either ignoring otherwise important information or not giving it as much as attention as we normally would. Content reduction – identifying important, relevant content – becomes important in this situation. VIRT (Valued Information at the Right Time) [2] is proposed as one possible approach to identifying important information and delivering to the user when he needs it.

The multiplicity of our communication channels, our schedules and our context during the various activities we are involved in, makes the task of keeping in touch with urgent, important information challenging. Our context includes the activity we are involved in (meetings, classes, conferences etc), the devices we have access to (smart phones, cell phone, laptops etc), and the mode in which the devices are available (muted or not).

Our key insight is that to enable mobile office workers to keep in touch with urgent communication, their context plays a key role. In this rest of paper we will delve on this topic and present a system currently under development.

2. USER CONTEXT
The ability to handle requests for unexpected and urgent tasks is an important part of our work and personal life. The very first step in handling such requests is to become aware of them. While we all have multiple ways to send and receive information, their availability is dictated by our context.

For most of us, our context changes several times during the course of a day. For those in academia, we are involved in a number of different types of activities: teaching classes, attending office and research meetings, being at conferences, meeting with sponsors, do research, and writing papers etc. For people in other professions, their activity types may be different from ours but like us, they also transition from one activity to another as their day progresses.

Each user activity is characterized by a number of attributes such as type, date, time, and location. For each meeting type, our context is further defined by which communication channels are available to us. When we are teaching, we are very limited in how the outside world may communicate with us. During off-site conferences, most of us have access to our cell phones and possibly laptop computers on wireless networks. When we are listening to paper presentations at the conference, our cell phone will most likely be muted.

If we can capture information on user context, we can deliver urgent information to the user through a communication channel which is most conveniently available to the user. We need to glean urgent information out of the glut of information we receive so that it can be delivered.

2.1 Information Value Awareness

From an information-value perspective, there are at least the following types of information that can be identified

1. Urgent
2. Important but not urgent
3. Urgent but not important – Urgent requests for information/action which lead to nothing meaningful. (In the academic settings, urgent calls from the provost for information fall in this category ☺)
4. Not important, not urgent, like SPAM – captures responses from individuals who are in the habit of copying their responses to all, irrespective of whether they are relevant to all or not.
5. SPAM

When our attention and device resources are limited, most of us would want to be alerted about the urgent category of messages only. These messages need to be delivered to us in a format that is suitable for the device available the moment (defined by our context at the time of delivery).

2.2 Delivering in the right format

With 69% of the US population using cell phones [4], it has become the most ubiquitous mobile communication device today. Given the data networking and computing capability of most recent cell phones, they can be used for much more than just voice communication. Today's cell phones are powerful enough to support email, SMS, MMS, web access and video/audio streaming. Given the ubiquity and mobility of the cell phones, it can be used as a primary device for keeping in touch with urgent and important information.

The current generation of phones is capable of doing a lot for us but their ability to display, store and process information is obviously limited compared to desktop or laptop computers. Their small screens, for example, are not suitable for displaying large documents, and, given that wireless networks costs are high, one may not want to receive everything sent to us. Therefore simple-minded forwarding of all information sent to our various channels to our cell phones will not work – it will overwhelm the device, it will overwhelm the user, and hence defeat the purpose of the alert system. The way to handle this problem is to send only that information to the user which is urgent and important to him and to package this information in a way that the device and the network can handle it.

The information needs to be sent to the user device a format in which it is most convenient for the user. For example, we know that user in a meeting is contactable on cell phone which is in a muted mode we can send information through an SMS. If we know that the same user will be driving during that time, we should send info through a phone call instead (hopefully he will receive this call on hands-free system!).

2.3 Content Repurposing – Device and Network Awareness

In recent years, there has been a rapid increase in the types of devices and networks available for information access. In the case of cell phones alone, there are more than 600 different device profiles, each differing in display, user interface, audio, processing and storage capability. There are many different network profiles available as well, and they differ in their bandwidth, latency, availability and cost. To deliver information to such a diverse set, it needs to repurposed to match the exact device and network type to which it is being delivered [6]. For example, there is no point in delivering a large street map in its full size to a cell phone with a small display connected on a slow network. It would be best to match the map images to the display and processing capability of the phone. It would also lead to a significant reduction in network traffic, saving both time and cost for the user.

3. IMAS – Integrated Mobile Alert System

A system, called IMAS, incorporating the key ideas mentioned above is currently under development. It uses an extended online calendar to capture user's context information. A typical online calendar captures date, time, location and type of event (meeting, conference, teaching etc). In addition, the system enables the user to register his email accounts, various landline phones, and cell phone numbers. The user can then describe his most convenient way to reach him for urgent messages for each event type. For example, during office meetings, he can list his cell phone number as the most convenient way to reach him. He can also state that messages should be forwarded as SMSs when he is in meetings.

The other most important part of the system is to identify information that should be forwarded when the user is away from office. This is done by defining rules which implement various types of filters. For email, the user can filter such as emails from certain user ids, emails marked urgent, email addressed directly to the user only and emails with subject lines containing certain words. For phone calls, the user state caller ids which are considered important.

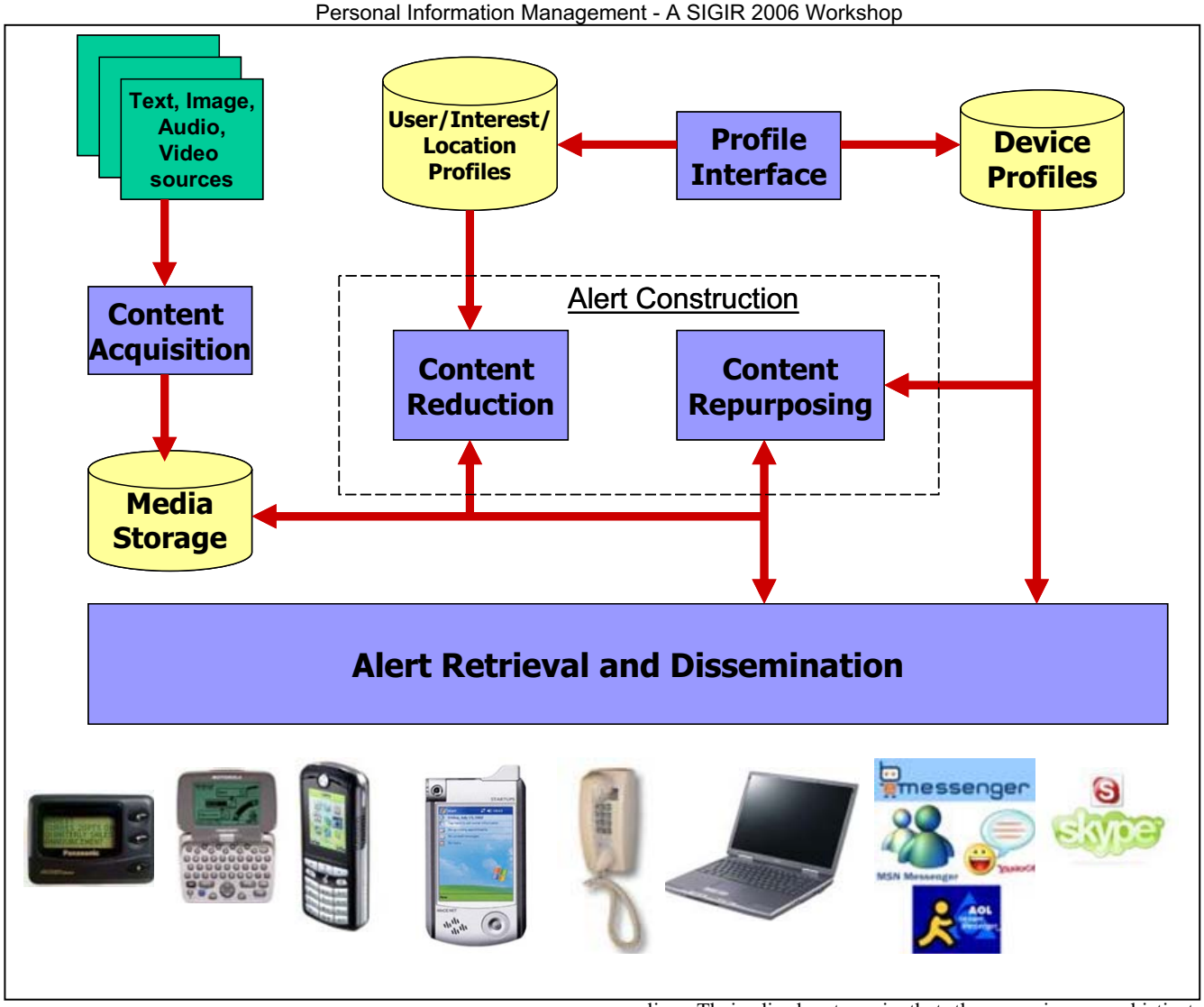
Once this information has been entered into the system, it keeps track of the user's context and starts forwarding information as desired by the user.

We are investigating the use of a number of different types of alerts. A high-level analysis of the various possibilities follows.

3.1 Sound Alerts

The most common example of a sound alert is ring tones used in phones. It is interesting to note that a large number of users customize ring tones on their cell phones but not on their desk phones even though the feature may be available. Ring tones can be used to identify certain individuals or groups of individuals. Also, a smart ring tone system can be used to distinguish between urgent and non-urgent calls by using a high-pitched tone for urgent calls.

A key disadvantage of ring tones is that they are intrusive in nature and lack privacy. When a phone rings, every one who can hear the ring knows that someone is calling the receiver. They are useful in noisy environments.



3.2 Speech Alerts

This is a replacement for the ring tone where the announcement can carry more information for the user; a part of the message can be delivered in the ring (e.g., "Urgent call from Joe"). These types of alerts are used very effectively in in-vehicle navigation systems.

One disadvantage of such alert systems is that they may be hard to hear in noisy environments and even more prone to privacy issues than the sound alerts.

3.3 Text Alerts

The most common example of text alerts is SMS. Here a short text message (maximum 160 characters) is delivered to the users handheld device. These messages are least intrusive, cheap and effective for short messages. The disadvantage of these types of alerts is that one has to look at the device screen to read the message.

3.4 Multimedia Alerts

Multimedia alerts can carry the messages that include images and videos. The most common implementation is done through MMS systems in phones. These are effective for conveying complex information such as street maps, graphs, photos and short video clips. Their disadvantage is that they require a sophisticated device to deliver (which most of the phones are today). Just like in the case of text alerts, the user has to look at the device screen to get the message. The delivery of such message also requires the device to be on a high-bandwidth connection, specially in the case of videos.

3.5 Silent Alerts

Silent alerts are least invasive in nature and provide a high-degree of privacy by alerting the user by using a number of means including vibrations and low-intensity electric shock [5]. They are also very useful for alerting handicapped users who may not be able to hear or read. The method of alerting can be used to encode a part of the message as well. For example, one can use different frequency or patterns of vibrations to identify the sender of the message.

One difficulty with silent alerts is that the device has to be close to the user's body to perceive the alert.

4. CURRENT STATUS

The above figure shows the overall architecture of the system. Parts of the system have been implemented and tested whereas other parts of under active development.

Le and Hsu [3] have developed the online calendaring and user profiling part of the system. User profiles capture user specific data such as the various email account ids and desk and cell phone numbers. In addition, it enables the user to specify devices available during his various context settings. For example, a user may state that when he is in an off-site meeting, the only way of contacting his is his cell phone. In this mode, he would like to receive urgent emails as SMSs.

This system is able to automatically filter information based on the users context information and forward it in the right format based on the user device. The remaining parts of the system are currently under development.

5. SUMMARY AND CONCLUSIONS

PIM has typically focused on storage, indexing, search and retrieval of personal information. To support mobile workers, the scope of PIM needs to be expanded to include functions that enable the user to receive urgent information on an available platform and in a convenient fashion. This requires us to understand user's context, filter information based on his requirements, package the filtered information for delivery based on his device, and then deliver it.

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