Works in Progress

Editor: Anthony D. Joseph ■ UC Berkeley ■ adja@cs.berkeley.edu

Mobile and Ubiquitous Objects

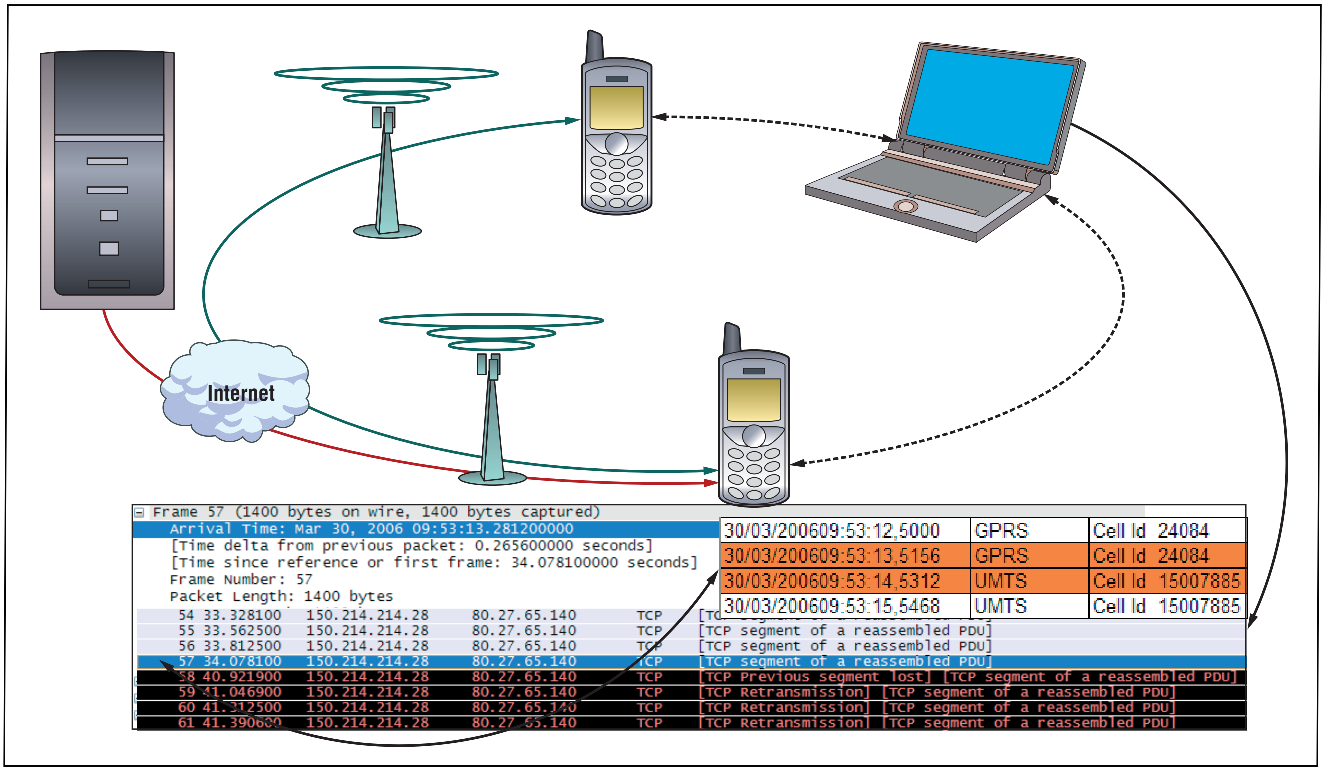
COMMUNICATION AWARENESS IN MOBILE DEVICES

Almudena Díaz, Pedro Merino, and F. Javier Rivas, University of Malaga

The University of Malaga's wireless communications and pervasive computing team is developing software tools to enhance distributed mobile applications' development and deployment phases (see figure 1).

From our group's experience in developing software for smart phones, we've noticed a lack of tools to assist testing and debugging communication-intensive applications. Most application developers use computer resident emulators to develop, analyze, and test new applications for mobile devices; however, the application's actual behavior is always different in the target device. So, our first aim was to obtain tools based on wireless devices (the emulator doesn't simulate everything).

On the other hand, traditional methods for analyzing mobile data communications' performance in realistic scenarios were based on trials, using mobile devices only as modems with the applications running in a laptop.



```
⊟ Frame 57 (1400 bytes on wire, 1400 bytes captured)
    Arrival Time: Mar 30, 2006 09:53:13.281200000
    [Time delta from previous packet: 0.265600000 seconds]
    [Time since reference or first frame: 34.078100000 seconds]
    Frame Number: 57
    Packet Length: 1400 bytes
   54 33.328100   150.214.214.28    80.27.65.140      TCP      [TC
   55 33.562500   150.214.214.28    80.27.65.140      TCP      [TCP segment of a reassembled PDU]
   56 33.812500   150.214.214.28    80.27.65.140      TCP      [TCP segment of a reassembled PDU]
   57 34.078100   150.214.214.28    80.27.65.140      TCP      [TCP segment of a reassembled PDU]
   58 40.921900   150.214.214.28    80.27.65.140      TCP      [TCP Previous segment lost] [TCP segment of a reassembled PDU]
   59 41.046900   150.214.214.28    80.27.65.140      TCP      [TCP Retransmission] [TCP segment of a reassembled PDU]
   60 41.312500   150.214.214.28    80.27.65.140      TCP      [TCP Retransmission] [TCP segment of a reassembled PDU]
   61 41.390600   150.214.214.28    80.27.65.140      TCP      [TCP Retransmission] [TCP segment of a reassembled PDU]
```

30/03/200609:53:12,5000	GPRS	Cell Id 24084
30/03/200609:53:13,5156	GPRS	Cell Id 24084
30/03/200609:53:14,5312	UMTS	Cell Id 15007885
30/03/200609:53:15,5468	UMTS	Cell Id 15007885

Figure 1. An example of communication awareness in mobile devices. Packet losses detection in handovers between General Packet Radio Service and Universal Mobile Telecommunications Systems could be used for cross-layer optimizations in heterogeneous networks.

Published by the IEEE CS and IEEE ComSoc ■ 1536-1268/06/$20.00 © 2006 IEEE

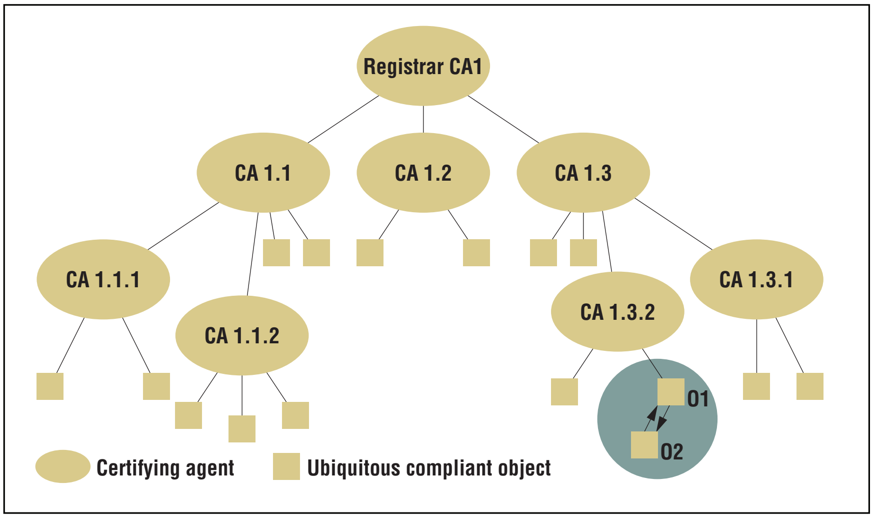


Figure 2. A certifying agent's tree structure.

Measurements based on this scenario are no longer interesting because

- current devices have enough processing power to execute both the application and the monitoring software inside the terminal, and
- many applications have been specifically designed for mobile devices, and porting them to the modem-laptop scenario only for evaluation purposes is too costly.

We provide a uniform solution to both problems by designing and implementing middleware for wireless-communication awareness that analyzes

- new communication protocols in mobile environments,
- correlation between mobility events (such as handover and roaming between different radio-access technologies) and communication performance,
- metrics for benchmarking communications in mobile applications, and
- security weakness and malicious applications in mobile devices.

For more information, contact Almudena Díaz at almudiaz@lcc.uma.es or see www.lcc.uma.es/~pedro/mobile.

UBIQUITOUS OBJECTS: A SECURITY-TOKEN-BASED AUTHENTICATION MODEL AND CATEGORIZATION AND IDENTITY

Umakant P. Kulkarni, Jayateerth V. Vadavi, G.S. Thyagaraju, and Shrihari M. Joshi, *SDM College of Engineering and Technology*
Anil R. Yardi, *Walchand College of Engineering and Technology*

Our research group is investigating two issues related to ubiquitous objects: creating a model to combat security risks and access-control problems and developing a protocol to facilitate communication between various objects.

Security

In ubiquitous computing environments, compliant objects can access resources and services anytime and anywhere. This leads to serious security risks and access-control problems because almost anyone with a mobile device can access these resources. Like any other significant computing system, autonomic systems must be secure. Many autonomic systems use new techniques and architectures whose security implications aren't yet well understood. Distributed system architectures connecting many computers raise questions on how to better protect system information and resources. If autonomic systems are to reduce human administration costs, they shouldn't rely on humans to notice anomalous behavior resulting from security compromises.

Because many autonomic systems must deal with a constantly changing set of other systems as suppliers, customers, and partners, they need flexible new methods for reliably establishing trust, detecting attacks and compromise, and recovering from security incidents.

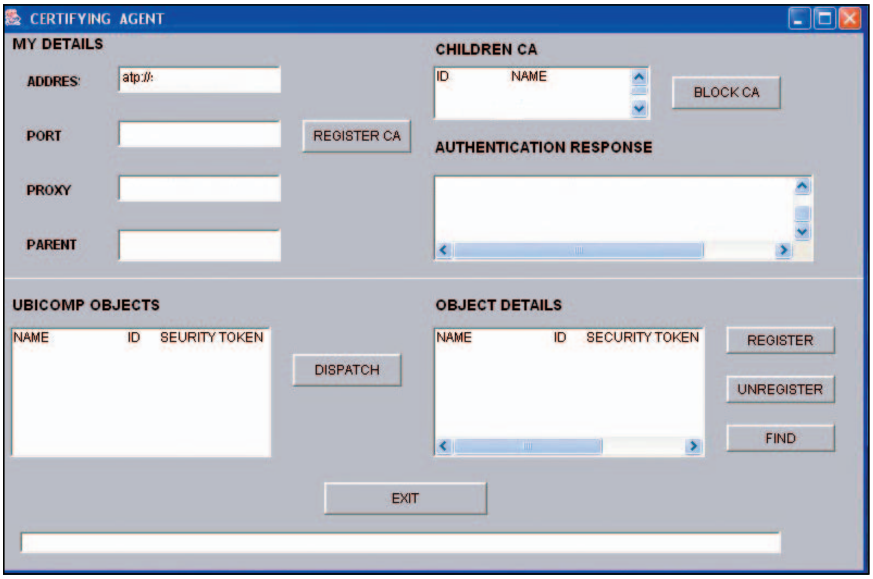
Our work proposes a new access model, which uses a hierarchical tree-based approach for authenticating ubiquitous objects. Based on security tokens, our authentication model operates in a multilevel security environment, which is modeled as a forest of hosts operating as certifying agents. CAs authenticate the ubiquitous objects for communication. CAs are arranged in the form of a tree. Each CA maintains information about its immediate descendants (which can be CAs or ubiquitous objects) registered with it (see figure 2).

Our model's central idea is to efficiently spread important information over several separate CAs so that the information is highly available, reliable, self-correcting, and self-protecting. We use mobile agents to implement this model. Its design is complete, and implementation is in progress. Figure 3 shows the CA's GUI.

Communication

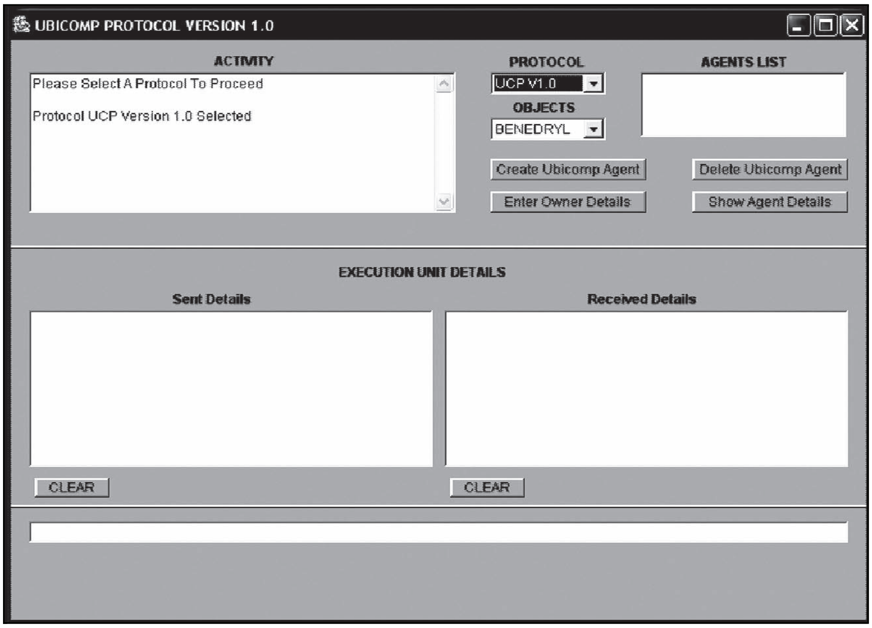
Ubicomp's growth indicates that numerous users and objects will interact with one another simultaneously in the future. This poses the question of how to uniquely identify an infinitely increasing number of ubiquitous objects and standardize the data they're exchanging.

We're developing a protocol to address this question. We're proposing a standard format for the ubiquitous data that the various ubiquitous objects exchange. We've selected one ubiqui-



ADDRES: atp://

Figure 3. A certifying agent's GUI.



Please Select A Protocol To Proceed

Protocol UCP Version 1.0 Selected

PROTOCOL: UCP V1.0

OBJECTS: BENEDRYL

Figure 4. A refrigerator object's GUI.

tous application and are simulating the ubiquitous environment to demonstrate the communication among objects using our protocol. We considered the communication between a Refrigerator object and an Owner object (Mobile), which acts as the Owner of a Refrigerator object. The Owner object can query the Refrigerator about objects present in the Refrigerator. Additionally, the Owner object will regularly receive critical information about the objects present in the Refrigerator. The object identity, classification, and protocol are scalable. We're conducting the simulation in the Mobile Agents paradigm.

Figure 4 shows the functional design for the Refrigerator object.

For more information on either project, contact Umakant P. Kulkarni at prof_ard@yahoo.com. ℙ

How to Reach Us

Writers

For detailed information on submitting articles, write for our Editorial Guidelines (pervasive@computer.org) or access www.computer.org/pervasive/author.htm.

Letters to the Editor

Send letters to

Shani Murray, Lead Editor
IEEE Pervasive Computing
10662 Los Vaqueros Circle
Los Alamitos, CA 90720
pervasive@computer.org

Please provide an email address or daytime phone number with your letter.

On the Web

Access www.computer.org/pervasive or http://dsonline.computer.org for information about *IEEE Pervasive Computing*.

Subscription Change of Address

Send change-of-address requests for magazine subscriptions to address.change@ieee.org. Be sure to specify *IEEE Pervasive Computing*.

Membership Change of Address

Send change-of-address requests for the membership directory to directory.updates@computer.org.

Missing or Damaged Copies

If you are missing an issue or you received a damaged copy, contact membership@computer.org.

Reprints of Articles

For price information or to order reprints, send email to pervasive@computer.org or fax +1 714 821 4010.

Reprint Permission

To obtain permission to reprint an article, contact William Hagen, IEEE Copyrights and Trademarks Manager, at copyrights@ieee.org.

IEEE pervasive COMPUTING
MOBILE AND UBIQUITOUS SYSTEMS