

Integrated Profile Management for Mobile Computing

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Introduction

Goal

- Defining and exploiting rich integrated profiles to adapt internet services in a mobile environment

Motivation

- Proliferation of mobile devices with different capabilities
- Mobility and multiple devices introduce
 - Different preferences on different devices
 - Different preferences on different action-contexts
 - Different services depending on location
 - Different services depending on network infrastructure
 - Session switching between devices
- Both users and content providers will specify preferences and policies for the adaptation of both content and presentation

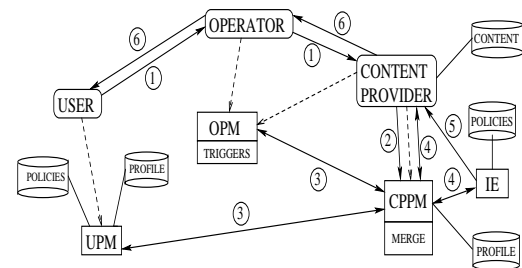
Introduction (2)

Rich user profile information includes:

- Device
- User Personal Data
- Infrastructure/Location
- Action context
- Content

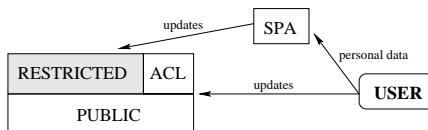
- Profile information is typically distributed (users, network operators, content providers)

Architectural View



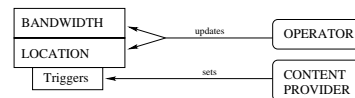
User Profile Manager

- Manages user-related information
- Users can declare policies regarding content and presentation preferences
- Privacy: Access Control List
 - public: *emailAddress*
 - Restricted (explicit): *creditCardData*
 - Restricted (induced): *interests* (induced from user behaviour)
- Profile data induction: Semantic Profile Assistant



Operator Profile Manager

- Manages network context information
- Changes are frequent and unpredictable
- Content providers should specify triggers for notification



Content Provider Profile Manager

- Manages proprietary profile data, possibly obtained through CRM
- Merges profile data obtained by different sources
 - Conflicts may arise when different entities provide different values for the same attribute
 - Content providers can declare priorities over data sources at attribute level
- Performs session management

Inference Engine

- Evaluates user and content provider policies against profile data
- Resolves policy conflicts
- Provides presentational attributes

Research Issues

- Language for describing profile information
- Merging profile data
- Language for describing policies
- Evaluating policies

Language for Describing Profile Information

- Composite Capabilities/Preference Profile (CC/PP)
- We are defining new vocabularies for:
 - network status
 - action context
 - personal information
 - content

```
<ccpp:Attribute rdf:ID="PreferredMedia">
  <rdfs:label xml:lang="en">Attribute: PreferredMedia</rdfs:label>
  <rdfs:range rdf:resource="#ns-rdf;Seq" />
  <rdfs:domain rdf:resource="#PresentationDirectives"/>
  <rdfs:comment xml:lang="en">
    Description: Indicates the user's preferred media.
    Type: Seq
    Examples: "plain-text", "audio", "video", ...
  </rdfs:comment>
</ccpp:Attribute>
```

Merging Profile Data

- Problem: different values for the same attribute
 - userPM → Location = N19°02' E44°75'
 - operatorPM → Location = N18°56'68" E44°26'10"
 - How to resolve this conflict?
- Solution: priorities over data suppliers
 - Define priorities at attribute level
 - Priority(Location) = < Operator, User, CP >

Language for Describing Policies

- Policies specified through a set of logical rules
- Antecedent: conditions on profile data
- Consequent:
 - User policies: new profile data:
 - IF device="cell phone" AND context="important meeting" THEN preferredMedia="text"
 - Content provider policies: new profile data or **presentational attributes**:
 - IF availableBandwidth="Low" AND preferredMedia="Audio" THEN audioBitrate="24Kbps"
- Policy evaluation:
 - Core algorithm of the Inference Engine (IE)
 - Policy conflicts resolution

Work in Progress and Open Issues

- CC/PP and RDF
- Querying CC/PP profiles: XPATH vs RDQL
- Policy formalization
- Policy conflicts resolution

Open Issues (CC/PP and RDF)

- CC/PP has a poor hierarchical structure
- Semantics is defined using the *comment* tag:

```
<ocpp:Attribute rdf:about='sns-ocpp-client:color'>
{...}
<rdf:comment xml:lang='en'>
  For display or print devices, an indication of the color rendering
capabilities:
  binary - indicates bi-level color (black-and-white, or similar).
  gray - indicates gray scale capability
  limited - (...)
  mapped - (...)
  full - (...)
</rdf:comment>
</ocpp:Attribute>
```
- RDF is not a consolidated technology
- RDF is not widely adopted by industry
- Is RDF for CC/PP really better than XML?

Work in Progress (Retrieving attribute values)

- Attributes must be addressed through *vocabulary*, *component* and *attribute name*.
 - Location → <http://example.com/vocab#:Network:Location>
- Language for querying RDF documents
 - XPATH is inadequate: the XML serialization of an RDF graph is not unique
 - Solution: RDQL

```
SELECT ?attributeValue
FROM <http://webdid.usr.dico.unimi.it/~devel/user4533.rdf>
WHERE
  (<expro:Network>, <expro:Location>, ?attributeValue)
USING
  expro for <http://webdid.usr.dico.unimi.it/~devel/expro-
  schema#>
```

Work in Progress (policy management)

- Policy formalization
 - Datalog programs
 - Function-free Horn clause programs
 - Is recursion needed? Is negation needed?
- Policy conflict resolution
 - Conflicts intra agent:
 - Values induced by policies have higher priority over values explicitly furnished
 - Conflicts inter agents:
 - Apply the same priorities defined for the explicit values
 - Evaluate policies using stratification

Conclusions

- We have defined an architecture to adapt internet services in a mobile environment by exploiting integrated profile information
- We are currently working on the details of the Inference Engine module and designing a first prototype

We present the general architecture at the AI2IA ("Artificial Intelligence moves to Information Access") workshop associated with IJCAI-03.
(paper downloadable from <http://webmind.dico.unimi.it>)