(51) **International Patent Classification:** Not classified

(21) **International Application Number:**
PCT/US2005/037022

(22) **International Filing Date:** 17 October 2005 (17.10.2005)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
0423307.8   20 October 2004 (20.10.2004)   GB

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** APPARATUS AND METHOD FOR DETERMINING A USER PREFERENCE
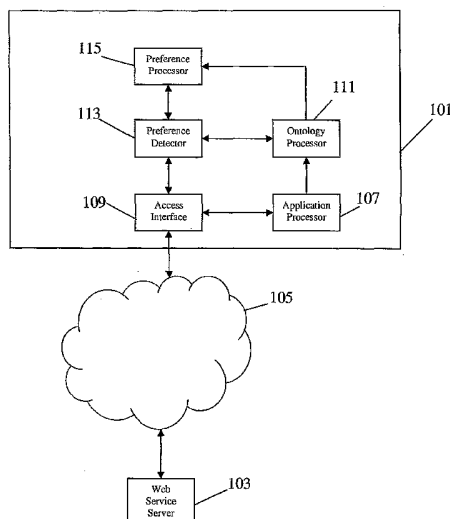
(57) **Abstract:** A user device comprises an access interface (109) for accessing a web service by exchanging information with the web service over the Internet (105). An application processor (107) executes a user application accessing the web service through the access interface (109) and the Internet (105). The application processor (107) is connected to an ontology processor (111) which determines an ontology associated with at least some of the information exchanged with the web service. For example, the ontology may relate to a data structure of data objects communicated between the application processor (107) and the web service. The user device (101) further comprises a preference detector (113) which determines a user preference indication in response to the ontology and the exchanged information. The preference detector (113) is connected to a preference processor (115) which determines a user preference in response to the user preference indication.

APPARATUS AND METHOD FOR DETERMINING A USER PREFERENCE

Field of the invention

5

The invention relates to a method and apparatus for determining a user preference in response to an access of a web service.

10

Background of the Invention

In the last decade, the popularity of the Internet has increased explosively and an increasing number of

15 services and applications exploiting the potential of the Internet have been developed.

In recent years, the concept of web services has been introduced. In contrast to traditional web browsing

20 services wherein a web site interfaces directly with a user, a web service provides for a serving application to interface with a client application. The client application may provide a user interface for presenting information to a user and for receiving a user input.

25 Hence, web services generally describe specific functionality by e.g. a company for providing another application the service through typically an Internet connection.

30 The opportunities offered by web services are very attractive for many service providers and a complete framework has been defined for some web services in order to allow a broad and standardised operation. In

particular, a framework has been established for some

web services in order to allow applications to

interface with the web services without prior

knowledge of exact characteristics and requirements

5 of the service. The framework provides for exchange

of information between the application and the web

service in order to allow the application to be

modified. For example, the framework provides for a

service description to be provided to the application

10 allowing the application to determine the input

parameters required by the service and the output

results that may be obtained. This service

description is a key enabler for service discovery

and invocation in many web service applications.

15

In particular the communication protocols UDDI

(Universal Description, Discovery and Integration)

and WSDL (Web Service Description Language) have been

defined by W3C (World Wide Web Consortium) for

20 setting up web services. The communication protocol

UDDI is used for registering a web service on a

centralised repository or service directory, which

for example may be accessed as a web site. Hence UDDI

is used by the web service when publicising and

25 advertising the service. UDDI specifically allows

exchange of information identifying the type of

service and the entity providing the service.

WSDL is a communication protocol which is used for

30 exchanging information directly between the web

service and an application. WSDL provides for a

description of inputs, outputs, operations and

messages which are generated or required by the

service. Thus, WSDL provides for an interface
description for the web service that allows an
application to adapt to the current web service.
During operation, the user application and the web
5 service exchange information. In particular, the
information may be exchanged using the SOAP protocol
which has been defined by W3C. Specifically, the
application and web service may exchange SOAP
messages containing instances of inputs and outputs
10 over typically the Internet.

The WSDL description of inputs and outputs identifies
resources needed to run the service correctly. Those
resources can be defined into a language known as XML
15 Schema. The purpose of an XML Schema is to define the
legal building blocks of an XML document, just like a
DTD (Document Type Definition). However, in semantic
web services the resources may be represented by
elements of an ontological vocabulary, represented
20 into an XML-based ontological representation language
such as RDFS(Resource Description Framework Schema).

An ontology is a shared understanding of some domain
of interest. In particular, an ontology provides a
25 reference frame and definition for various concepts
used in a particular domain. A concept can be a
physical (concrete) object of the domain (a book in
the domain of book sellers) or an abstract object
(the selling book process in the domain of book
30 sellers). A number of different properties
(parameters and characteristics) of a given concept
may be represented in an ontology. Thus, for a
defined ontology which is shared between applications

and web services, the different applications and web
services may exchange information relating to
characteristics of objects (concrete or abstract) by
using the defined ontology. This allows web services
5 and applications to accurately and effectively
exchange information without requiring the objects to
be predefined at the time of the design of the web
services and applications. Thus ontologies are used
for sharing a consistent understanding of what
10 information means and also allows knowledge re-use as
a common reference for different web services and
applications.

In order to enhance the user experience, there is a
15 desire to personalize web services for the individual
user. However, the personalization of services or
applications is problematic and is typically addressed
from the service or application perspective. Hence, web
services are known which develop and store internal user
20 profiles allowing them to customize the service based on
user preferences. However, this knowledge about the user
is local to the particular service and therefore cannot
be reused by the user for another service even if this
service is of the same type.

25

An approach that has been adopted to address this problem
is to define a user model for applications. However, the
definition of such user models has mainly been addressed
for standalone applications. In such context, the user
30 model contains type of preferences that are defined at
the time of the design of the application (e.g. editing
preferences, display preferences etc.). However, this

results in an inflexible and static personalization of web services from the user perspective, because the set of predefined type of preferences can not be extended or change at run time. For example, a user may change

5 preferences or develop new preferences during use, and it is therefore not possible to generate an accurate user profiled during the design phase. From the user perspective it is difficult to define at design time, which type of preferences the system will use to access

10 any kind of services or applications.

Although some approaches have been proposed for modifying or updating such user profiles, these approaches tend to be very complex, require large storage and to be

15 dependent on specific characteristics of the individual service.

Hence, an improved system for determining a user preference would be advantageous and in particular a

20 system allowing increased flexibility, reduced complexity, reduced storage requirements, improved portability, improved compatibility with different services, improved accuracy, applicability to different web services and/or improved personalisation of web

25 services would be advantageous.

Summary of the Invention

30 Accordingly, the Invention seeks to preferably mitigate, alleviate or eliminate one or more of the above mentioned disadvantages singly or in any combination.

According to a first aspect of the invention, there is provided an apparatus for determining a user preference comprising: means for accessing a web service by

5 exchanging information with the web service; means for determining an ontology associated with at least some information exchanged with the web service; means for determining a user preference indication in response to the ontology and the at least some information; and means

10 for determining the user preference in response to the user preference indication.

The invention may allow in improved user preference to be determined. The invention may in particular enable or

15 facilitate user preference (e.g. preference type and/or preference value) determination based on actual web service access characteristics. A user preference may be determined at run time for an application rather than requiring a user preference to be determined when

20 designing the application. The invention may facilitate determining a user preference which is not limited to the specific web service and/or does not require all characteristics of the web service to be known in advance. A highly flexible system for determining a user

25 preference may be provided. The system may be compatible with a large range of web services and in particular an ontology based approach may allow user preference indications to be determined based on information from interactions with the web service without the application

30 having predetermined (design time) information of characteristics of this information.

Hence, by representing information exchanged with the web
service by an ontology representation language, web
service interoperability and application run-time
configurability may be facilitated and/or improved. For
5 example, by including ontological elements in web service
descriptions, the web service provider may ensure that a
common understanding of the inputs and outputs of the web
service is achieved thereby facilitating user preference
determination based on this input and/or output.
10

The invention may enable or facilitate a dynamic
creation or modification of a user preference based on
interactions between the application and web services.

15 The invention may allow a more dynamic and/or variable
user preference to be developed. For example, the
invention may facilitate detection of new preferences as
these may readily be detected based on the ontology
information.
20

The exchanged information may be sent to the web service
and/or received from the web service. In some
embodiments, the user preference indication may in itself
be a user preference and in particular the determined
25 user preference and the user preference indication may be
identical.

According to an optional feature, the at least some
information comprises data objects comprising a data
30 structure compliant with the ontology. This may
facilitate and/or improve the determination of the user
preference. The data objects may for example relate to

items, such as a book, to be purchased or information
elements being exchanged, such as tourist information.

According to an optional feature, the at least some
5 information comprise SOAP messages. This may provide an
efficient implementation and may in particular provide
compatibility with web service frameworks specified by
W3C.

10 According to an optional feature, the means for
determining the ontology is operable to determine the
ontology in response to received information associated
with the web service. This may facilitate the
determination of the ontology and/or may provide a
15 flexible and/or low complexity means of dynamically
adapting the operation to the current characteristics.
The received information may for example comprise a
specific data object description received from the web
service during access initiation. The specific data
20 object description may comprise an identification of data
objects to be exchanged and may provide an ontology
indication for one or more of these data objects.

According to an optional feature, the received
25 information comprises WSDL information. This may provide
an efficient implementation and may in particular provide
compatibility with web service frameworks specified by
W3C.

30 According to an optional feature, the means for
determining the user preference indication is operable to
determine the user preference in response to a service
type of the web service. This may provide for a low

9

complexity implementation and/or provide an improved quality user preference. In particular it may in many embodiments provide for a simple yet accurate determination of the user preference.

5

According to an optional feature, the means for determining the user preference indication is operable to determine the user preference in response to a service description of the web service. This may provide for a

10 low complexity implementation and/or provide an improved quality user preference. In particular it may in many embodiments provide for a simple yet accurate determination of the user preference.

15 According to an optional feature, the means for determining the user preference indication is operable to determine the user preference in response to a service instance message associated with the web service. This may provide for a low complexity implementation and/or

20 provide an improved quality user preference. In particular it may in many embodiments provide for a simple yet accurate determination of the user preference.

According to an optional feature, the service instance

25 message is an output service instance message from the web service. This may provide for a low complexity implementation and/or provide an improved quality user preference. In particular, it may in many embodiments provide for a simple yet accurate determination of the

30 user preference. In many embodiments, the output service instances may provide additional information which cannot be determined from the input service instance messages. For example, for a purchasing web service, an input

service instance may require selection of a product, such
as a book, by specific parameters, such as a title.
However, the output instance message comprising data of
the selected product, such as the selected book, may

5 provide much more information, such as a physical size,
number of pages etc. Hence, the output instance message
may provide information which cannot be derived from the
input instance messages thereby allowing for additional
user preference determination.

10

According to an optional feature, the apparatus further
comprises means for creating a user preference in
response to a detection of a service type of the web
service meeting a criterion. This may provide for a low

15 complexity implementation and/or provide an improved
quality user preference. In particular, it may in many
embodiments provide for a simple yet accurate
determination of the user preference. The criterion may
be used to bias the user preference determination towards

20 a desired characteristic or behaviour. For example, the
criterion may be that the service type is a new or rarely
accessed service type thereby biasing the user preference
determination towards detecting new preferences.

25 According to an optional feature, the apparatus further
comprises means for creating a user preference in
response to a detection of a service description
characteristic of the web service meeting a criterion.
This may provide for a low complexity implementation

30 and/or provide an improved quality user preference. In
particular, it may in many embodiments provide for a
simple yet accurate determination of the user preference.
The criterion may be used to bias the user preference

determination towards a desired characteristic or behaviour. For example, the criterion may be that the service description characteristic is indicative of a new or rare service characteristic thereby biasing the user
5 preference determination towards detecting new preferences.

According to an optional feature, the apparatus further comprises means for presenting the user preference
10 indication to a user; and the means for determining the user preference is further operable to determine the user preference in response to a user input. This may allow for the user preference to be controlled and/or influenced by the user. This may in particular allow a
15 more accurate user preference to be determined. For example, a new user preference may be determined and presented to the user. If the user agrees with the determination, the user preference may be maintained and otherwise it may be ignored.
20

According to an optional feature, the apparatus further comprises means for determining a user profile in response to the user preference. This may provide for an improved personalisation of the apparatus and may for
25 example provide an improved personalisation of future web services.

According to an optional feature, the apparatus further comprises means for storing the user profile using an
30 ontology representation. This may facilitate interoperability. In particular it may facilitate interoperability between different services and may for example allow a user preference to be determined in

response to accesses of a plurality of different services
and to be used for a plurality of different services.

According to an optional feature, the apparatus further

5 comprises means for accessing a different web service
using the user preference. The invention may allow a user
preference to be determined in response to accessing a
first web service which may be used for personalising a
second web service. In particular, by basing the user

10 preference determination on an ontology approach an
improved interoperability and compatibility between web
services may be achieved.

According to an optional feature, the apparatus further

15 comprises: means for accessing a different web service by
exchanging information with the different web service;
means for determining a second ontology associated with
at least some information exchanged with the different
web service; means for determining a second user

20 preference indication in response to the second ontology
and the at least some information exchanged with the
different web service; and means for updating the user
preference in response to the second user preference
indication.

25

The invention may allow a user preference to be
determined in response to a plurality of web services.
This may allow a more accurate user preference to be
determined. By basing the user preference determination

30 on an ontology approach, an improved interoperability and
compatibility between web services may be achieved. The
second ontology may be the same as the first ontology.

According to an optional feature, the apparatus further comprises means for generating a user recommendation in response to the user preference. The invention may allow for accurate user recommendations to be determined in

5 response to web service accesses

According to an optional feature, the means for determining the ontology is furthermore operable to determine the ontology in response to a service type of

10 the web service. This may provide a low complexity and practical determination of the ontology.

According to an optional feature, the apparatus further comprises means for estimating a consistency between the

15 user preference indication and an existing user preference; and the means for determining the user preference is operable to determine the user preference in response to the consistency. This may facilitate determination of the user preference and/or may increase

20 the reliability of the determined user preference.

According to an optional feature, a representation of the user preference is in accordance with the ontology. This may facilitate interoperability. In particular it may

25 facilitate interoperability between different services and may for example allow a user preference to be determined in response to accesses of a plurality of different services and to be used for a plurality of different services.

30

Optionally, the web service is a web service of a semantic web.

According to a second aspect of the invention, there is provided a method for determining a user preference comprising: accessing a web service by exchanging information with the web service; determining an ontology

5 associated with at least some information exchanged with the web service; determining a user preference indication in response to the ontology and the at least some information; and determining the user preference in response to the user preference indication.

10

These and other aspects, features and advantages of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

15

Brief Description of the Drawings

Embodiments of the invention will be described, by way of example only, with reference to the drawings, in which

20

FIG. 1 is an illustration of an example of a communication system comprising embodiments of the invention;

25 FIG. 2 illustrates an example of an upper level ontology in accordance with embodiments of the invention; and

FIG. 3 illustrates an example of a construction of a topology representation of a user preference in

30 accordance with embodiments of the invention.

Detailed Description of Embodiments of the Invention

The following description focuses on embodiments of the
invention applicable to a web service provided over the
Internet. However, it will be appreciated that the
5 invention is not limited to this application but may be
applied to many other networks and communication systems.

FIG. 1 is an illustration of an example of a
communication system comprising embodiments of the
10 invention.

The communication system comprises a user device 101
which is in communication with a web service server 103
through the Internet 105. The web service server 103
15 provides a web service which is accessed by the user
device 101. The user device 101 comprises an application
processor 107 which executes a user application that
interoperates with the web service executed by the web
service server 103.
20
The web service may for example be an online shopping web
service allowing a number of products, such as e.g.
books, to be purchased. The user application may thus
interface with a user of the user device 101 and the web
25 service in order to allow online product browsing,
product selection, payment etc.

The application processor 107 is coupled to an access
interface 109 which provides an interface to the Internet
30 105. The access interface 109 receives and transmits
information from and to the Internet and specifically
exchanges information with the web service. The access
interface 109 may comprise a broadband or dial up modem

as well as firmware for interfacing to other elements of
the user device.

The user device additionally comprises an ontology
5   processor 111 which determines an ontology for at least
some of the information being exchanged with the web
service. Specifically, the ontology may define a data
structure of some or all of the data objects or resources
which are exchanged with the web service. For example,
10 for an online shopping web service, the ontology may for
example define a data structure for the representation
and information exchange of data objects defining the
products. As another example, for an application
providing tourist information, the ontology may define a
15 data structure for information objects such as tourist
sights, hotels or restaurants.

In some embodiments, the ontology processor 111 may for
example determine the ontology in response to information
20 received from the web service and/or in response to a
service type of the web service. For example, the web
service may directly or indirectly communicate an
indication of which data objects will be used and which
ontology is used for these data objects. Additionally or
25 alternatively the ontology processor 111 may simply
select one or more ontologies suitable for the current
type of web service, e.g. if the current web service is a
an online book selling web service, the ontology stored
for book data objects may be selected.
30
In the embodiment of FIG. 1, the ontology processor 111
is coupled to the application processor 107. The
application processor 107 may in the example provide

information to the ontology processor 111 which allows
the appropriate ontology (or ontologies) to be
determined. For example, the application processor 107
may provide information to the ontology processor 111
5 indicating a service type and the ontology processor 111
may select an ontology from a number of stored
ontologies. For example, the application processor 107
may indicate that the user application relates to online
purchasing of books and in response the ontology
10 processor 111 may select a stored ontology defining a
data structure for data objects identifying books.

The information from the application processor 107 may be
independent of which specific web service is being
15 accessed. Hence, regardless of which online vendor of
books is providing the current web service, the same
ontology may be used.

The user device 101 further comprises a preference
20 detector 113 which may determine a user preference
indication. The preference detector 113 is coupled to the
ontology processor 111 and to the access interface 109.

In use, the preference detector 113 may determine a user
25 preference indication in response to the ontology and the
information exchanged with the web service. For example,
the preference detector 113 may monitor the communication
between the user application and the web service and may
interpret the communicated data using the ontology
30 determined by the ontology processor 111. E.g. the
preference detector 113 may detect all book selections
made by the user application and may interpret the data
objects using the selected ontology. For example, if a

user purchases a specific book, the preference detector
113 may determine the user preference indication as the
ontological representation of the book. In many
embodiments, the generated user preference indication is

5   represented in accordance with the ontology determined by
the ontology processor 111.

The preference detector 113 is coupled to a preference
processor 115 which is operable to receive the user

10 preference indication and to determine a user preference
depending on the user preference indication. In
particular, a user preference indication may be
determined for each object selected by the user
application and the preference processor 115 may

15 determine a user preference by identifying frequently
selected characteristics. Thus, if, for example, a large
number of books are purchased by a user, a user
preference indication may be generated for each purchase
and a user preference for e.g. a specific author may be

20 generated if a the proportion of purchased books with
this author exceeds a given level. In many embodiments,
the generated user preference is represented in
accordance with the ontology determined by the ontology
processor 111.

25

The ontology based approach allows for an improved
interoperability between different web services. For
example, each online book store may use the same ontology
for a book data object. Accordingly, the user preference

30 indication may be determined for all the web services
accessed for purchasing books. Thus, the user preference
may in particular be determined in response to accesses
of different web services. Accordingly, the generated

user preference may be used for different web services
and is not locally determined or specific to the web
service.

5   In some embodiments, the user device 101 is thus operable
to access different web services using the determined
user preference. For example, in some embodiments a user
preference may be determined in response to accessing a
first web service. When a second and similar type of web
10   service is subsequently accessed, the user device may
communicate the user preference (or parts thereof) to the
second web service thereby allowing this to be
personalised based on the information extracted when
accessing the first web service.
15
     FIG. 1 illustrates functional blocks of the user device
of some embodiments of the invention. The individual
functional blocks may for example be implemented in a
suitable processor such as a microprocessor, a
20   microcontroller or a digital signal processor. The
functions of the illustrated blocks may for example be
implemented as firmware or software routines running on
suitable processors or processing platforms. However,
one, more or all of the functional blocks may be
25   implemented fully or partially in hardware. For example,
the functional blocks may be fully or partially
implemented as analogue or digital logic or circuitry.

     The functional blocks may furthermore be implemented
30   separately or may be combined in any suitable way. For
example, the same processor or processing platform may
perform the functionality of more than one of the
functional blocks. In particular, a firmware or software

program of one processor may implement the functionality
of two or more of the illustrated functional blocks. For
example, the application processor 107, the ontology
processor 111, the preference detector 113 and the
5 preference processor 115 as well as elements of the
access interface 109 may be implemented as different
firmware routines running in a single processor. The
functionality of different functional modules may for
example be implemented as different sections of a single
10 firmware or software program, as different routines (e.g.
subroutines) of a firmware or software program or as
different firmware or software programs.

The functionality of the different functional modules may
15 be performed sequentially or may be performed fully or
partially in parallel. Parallel operation may include a
partial or full time overlap between the performed
functions.

20 The functional elements may be implemented in the same
physical or logical element or may be distributed across
a plurality of physical or logical elements.

The web service provided by the web service server 103
25 may in some embodiments be a web service of a semantic
web and may in particular in some embodiments operate in
accordance with the web service framework developed by
W3C. However, it will be appreciated that this is merely
an example and that for example any suitable service
30 description language and any suitable information
exchange protocol may be used.

In the example embodiments, the web service may use a
UDDI protocol for registering at a suitable web server,
WSDL for exchanging service description information and
SOAP messages for the ongoing interaction between the
5   user application and the web service.

In some of the exemplary embodiments, the available
web services may be partitioned into clusters based on
their type (as identified in the UDDI description or
10 in e.g. a OWL-S (Ontology Web Language – Service
Description Ontology) description of the service). The
web services communicate with the user application by
exchanging resources through SOAP request/response.
Those resources are collected and analysed by the user
15 device 101.

In a semantic web, the resources exchanged on the
Internet may be represented in accordance with
ontologies which specifically may be described in the
20 RDFS (Resource Description Framework Schema) or OWL
(Ontology Web Language) protocols. These ontologies
may thus be used to extract the user preference
indication and may be used to define user preferences
and to e.g. indicate preferred values of resource
25 properties. Thus, the use of ontologies may provide an
open and dynamic representation of user preferences.

FIG. 2 illustrates an example of an upper level
ontology which may be used. FIG. 2 in particular
30 illustrates an example of an ontology framework which
may be used to define any kind of preference. In the
specific example, a user preference is defined by
three main elements: the type of resource that

interest the user, the ontology where this resource is
described and a list of preferred properties. Each
preferred property is described by its name, the
chosen property value and the rating of this value.

5

In some embodiments, the preference detector 113 may
determine the user preference indication in response to a
service type of the web service and/or a service
description of the web service. For example, the
10 preference detector 113 may monitor the service
descriptions for a new web service and may determine a
user preference indication indicating that a specific
type web service has been accessed. The user preference
indication may thus indicate that the user has a
15 preference for e.g. the information or products
associated with this web service. In particular, the
preference detector 113 may generate a user preference
indication whenever it detects that a new type of service
is being accessed. Hence, if the user accesses an online
20 book seller for the first time, the preference detector
113 may generate a user preference indication indicating
that a user has an interest in online purchasing of
books.

25 Alternatively or additionally, the preference detector
113 may determine the user preference in response to a
service instance message associated with the web service.
The service instance message may be an input or output
message for the web service and may in particular be a
30 request or response SOAP message.

The preference processor 115 determines a user preference
in response to the user preference indication. The user

preference may be a new user preference indicating a newly detected preference or may be an existing user preference which is updated in response to the user preference indication. Thus, in combination, the user

5 preference indication and preference processor 115 may provide a learning function which may create and update an ontology based user preference in response to the accessing of web services.

10 Thus, in some embodiments the user device 101 may analyse the type of interest of the user based on the type of service identified by the UDDI and the WSDL description of the web service. The user device may thus monitor the type of service that the user

15 application is interacting with. A suitable learning strategy may be based on the observation that web service descriptions mainly provide a profile of the web service where inputs, outputs and functionalities of the service are described. Inputs are input

20 elements required to run the web service and outputs are output elements which provide the results of the web service to the user application. Some web services are known to generate local preferences in response to analysing the user inputs received from the user

25 application. However, the Inventors have realised that for many web services the output may be even more interesting for determining user preferences.

For example, input elements do not always comprise all

30 characteristics or parameters which may be used for developing a user preference and therefore additional information may be derived from the output. For example, an online book selling web service may

require the name of an author or the title of a book
in order to find a specific book. However, often
people may choose a book according to other parameters
such as the format or length of the book. E.g. people
5 predominantly reading books in public transport may
prefer a pocket format of any purchased book. This
preference may be detected by analysing similarities
of outputs from the web service identifying
characteristics of the purchased books.

10

In some embodiments, the user device may comprise
functionality for presenting the user preference
indication and/or the user preference to a user and for
receiving a user input. The user preference may then be
15 determined in response to the user input. For example,
the user preference may only be created if the user
accepts the presented information.

In some embodiments, a new user preference may be created
20 in response to a detection of a service type or a service
description characteristic of the web service meeting a
criterion. In particular, a new user preference may be
created when the preference detector 113 detects a new
web service type being accessed.

25

The preference processor 115 may for example
dynamically create a new user preference using the
ontology representation of FIG. 2 by instantiating the
concept of UserPreference. FIG. 3 illustrates an
30 example of a construction of a topology representation
of a user preference. In the specific example, an
ontology representation for a user preference for a
Restaurant is illustrated. An instance of Restaurant

can according to this exemplary ontology be described
with the full set of properties defined in the
ontology. In the example, the properties typeOfCuisine
and facilities are considered relevant for the current
5 user preference. In the example, in order to create a
new user preference, an instance of UserPreference and
several instances of PropertyPreference are simply
created using the upper ontology representation of
FIG. 2.
10

The representation is applicable to any type of
preference and dynamic environment since any new
preference can be defined on any new resource. The
representation language may for example be a RDF(S) or
15 OWL (Ontology Web Language ontology representation
language.

In some embodiments, the preference processor 115 may
further determine a user a user profile in response to
20 the user preference. The user profile may comprise a
number of user preferences for a large variety of web
services and/or data objects etc. The representation used
for the user profile may in particular be an ontology
representation and the user device 101 may comprise
25 functionality for storing the user profile using the
ontology representation.

The preference processor 115 may maintain a current user
profile by extracting existing preferences from the
30 current user profile and updating them according to user
preferences and user preference indications determined in
response to accesses of web services. For example, using
the ontology representation of FIG. 2 and 3, the

preference processor 115 may in response to a user
preference indication:

- Change the rating of an existing PropertyPreference
  in an existing UserPreference,
- Change the value and rating of an existing
  PropertyPreference,
- Add a new PropertyPreference to an existing
  UserPreference, or
- Add a new UserPreference with a set of
  PropertyPreference to the user profile.

In some embodiments, the user device 101 may comprise
functionality for generating a user recommendation in
response to a user preference. The user device may for
example receive information related to a different type
of web services or different types of information from a
web site. These may be compared to the current user
profile and if a match is found in accordance with any
suitable match criterion, the web service or the
information is presented to the user.

In some embodiments, the user device comprises
functionality for estimating a consistency between the
user preference indication and an existing user
preference. Hence, a verification check may be determined
when a new user preference indication is detected. If the
user preference indication is considered to be consistent
with the current user profile or user preference, the
user preference may be updated whereas it may be ignored
otherwise.

Specifically, in order to support such functionality
for resolving conflicts or inconsistencies various CSP
(Constraint Satisfaction Problem) may be used based on
for example simple rule management or more complex

5 control theory from planning and scheduling systems,
monotonic reasoning, or possible world theorems (The
person skilled in the art will appreciate that
numerous suitable CSP algorithms are available). Thus
in the example of the ontology representation of FIG.

10 2 and FIG. 3, the user device may determine that the
user preference indication is ignored if the user
preference indication is in conflict with the existing
user profile or e.g. a PropertyPreference of a
particular user preference.

15

It will be appreciated that the above description for
clarity has described embodiments of the invention with
reference to different functional units and processors.
However, it will be apparent that any suitable

20 distribution of functionality between different
functional units or processors may be used without
detracting from the invention. For example,
functionality illustrated to be performed by separate
processors or controllers may be performed by the same

25 processor or controllers. Hence, references to specific
functional units are only to be seen as references to
suitable means for providing the described functionality
rather than indicative of a strict logical or physical
structure or organization.

30

The invention can be implemented in any suitable form
including hardware, software, firmware or any combination
of these. The invention may optionally be implemented, at

least partly, as computer software running on one or more
data processors and/or digital signal processors. The
elements and components of an embodiment of the invention
may be physically, functionally and logically implemented

5   in any suitable way. Indeed the functionality may be
implemented in a single unit, in a plurality of units or
as part of other functional units. As such, the invention
may be implemented in a single unit or may be physically
and functionally distributed between different units and

10 processors.

Although the present invention has been described in
connection with some embodiments, it is not intended to
be limited to the specific form set forth herein. Rather,

15 the scope of the present invention is limited only by the
accompanying claims. Additionally, although a feature may
appear to be described in connection with particular
embodiments, one skilled in the art would recognize that
various features of the described embodiments may be

20 combined in accordance with the invention.   In the
claims, the term comprising does not exclude the presence
of other elements or steps.

Furthermore, although individually listed, a plurality of

25 means, elements or method steps may be implemented by
e.g. a single unit or processor. Additionally, although
individual features may be included in different claims,
these may possibly be advantageously combined, and the
inclusion in different claims does not imply that a

30 combination of features is not feasible and/or
advantageous. Also the inclusion of a feature in one
category of claims does not imply a limitation to this
category but rather indicates that the feature is equally

applicable to other claim categories as appropriate. Furthermore, the order of features in the claims do not imply any specific order in which the features must be worked and in particular the order of individual steps in 5 a method claim does not imply that the steps must be performed in this order. Rather, the steps may be performed in any suitable order. In addition, singular references do not exclude a plurality. Thus references to "a", "an", "first", "second" etc do not preclude a 10 plurality.

CLAIMS

1.   An apparatus for determining a user preference

5 comprising:

        means for accessing a web service by exchanging

information with the web service;

        means for determining an ontology associated with at

least some information exchanged with the web service;

10   means for determining a user preference indication

in response to the ontology and the at least some

information; and

        means for determining the user preference in

response to the user preference indication.

15

2.   The apparatus claimed in claim 1 wherein the at

least some information comprises data objects comprising

a data structure compliant with the ontology.

20 3.   The apparatus claimed in claim 1 or 2 wherein the at

least some information comprise SOAP (Simple Object

Access Protocol) messages.

4.   The apparatus claimed in any previous claim wherein

25 the means for determining the ontology is operable to

determine the ontology in response to received

information associated with the web service

5.   The apparatus claimed in claim 4 wherein the

30 received information comprises WSDL (Web Service

Description Language) information.

6.   The apparatus claimed in any previous claim wherein
the means for determining the user preference indication
is operable to determine the user preference in response
to a service type of the web service.

5

7.   The apparatus claimed in any previous claim wherein
the means for determining the user preference indication
is operable to determine the user preference in response
to a service description of the web service.

10

8.   The apparatus claimed in any previous claim wherein
the means for determining the user preference indication
is operable to determine the user preference in response
to a service instance message associated with the web

15 service.

9.   The apparatus claimed in claim 8 wherein the service
instance message is an output service instance message
from the web service.

20

10.   The apparatus claimed in any previous claim further
comprising means for creating a user preference in
response to a detection of a service type of the web
service meeting a criterion.

25

11.   The apparatus claimed in any previous claim further
comprising means for creating a user preference in
response to a detection of a service description
characteristic of the web service meeting a criterion.

30

12.   The apparatus claimed in any previous claim further
comprising means for presenting the user preference
indication to a user; and wherein the means for

determining the user preference is further operable to determine the user preference in response to a user input.

5   13.   The apparatus claimed in any previous claim further comprising means for determining a user profile in response to the user preference.

14.   The apparatus claimed in claim 13 further comprising
10 means for storing the user profile using an ontology representation.

15.   The apparatus claimed in any previous claim further comprising means for accessing a different web service
15 using the user preference.

16.   The apparatus claimed in any previous claim further comprising:
        means for accessing a different web service by
20 exchanging information with the different web service;
        means for determining a second ontology associated with at least some information exchanged with the different web service;
        means for determining a second user preference
25 indication in response to the second ontology and the at least some information exchanged with the different web service; and
        means for updating the user preference in response to the second user preference indication.
30

17.   The apparatus claimed in any previous claim further comprising means for generating a user recommendation in response to the user preference.

18. The apparatus claimed in any previous claim wherein
the means for determining the ontology is furthermore
operable to determine the ontology in response to a
5 service type of the web service.

19. The apparatus claimed in any previous claim further
comprising means for estimating a consistency between the
user preference indication and an existing user
10 preference; and the means for determining the user
preference is operable to determine the user preference
in response to the consistency.

20. The apparatus claimed in any previous claim wherein
15 the web service is a web service of a semantic web.

21. The apparatus claimed in any previous claim wherein
a representation of the user preference is in accordance
with the ontology.
20

22. A method of determining a user preference
comprising:
        accessing a web service by exchanging information
with the web service;
25   determining an ontology associated with at least
some information exchanged with the web service;
        determining a user preference indication in response
to the ontology and the at least some information; and
        determining the user preference in response to the
30 user preference indication.

23. A computer program enabling the carrying out of a
method according to claim 21.

24. A record carrier comprising a computer program as claimed in claim 22.
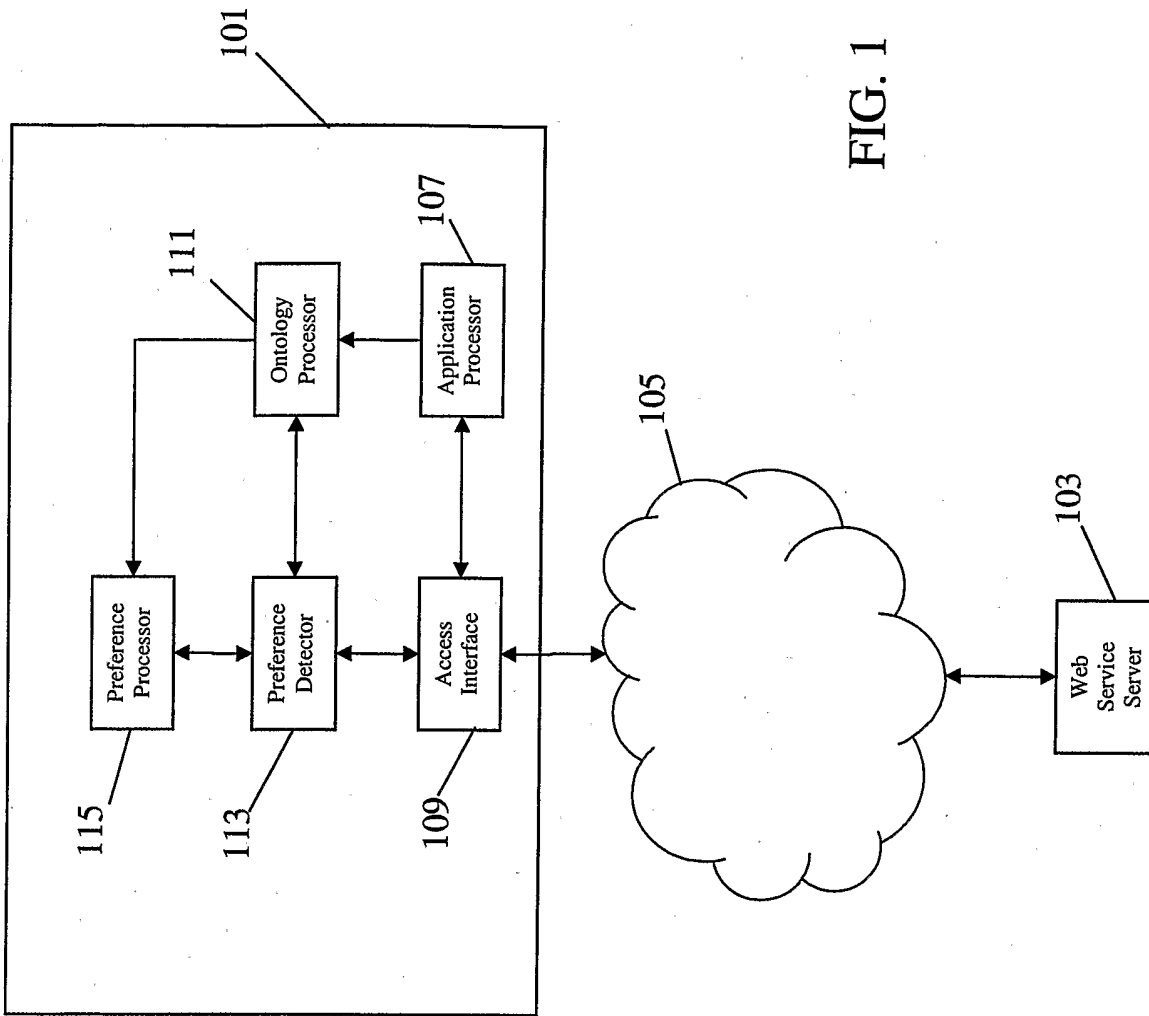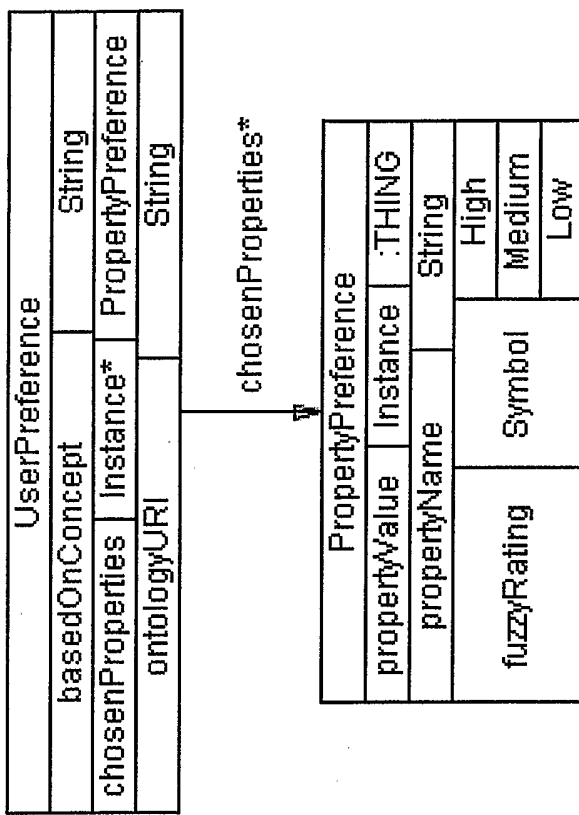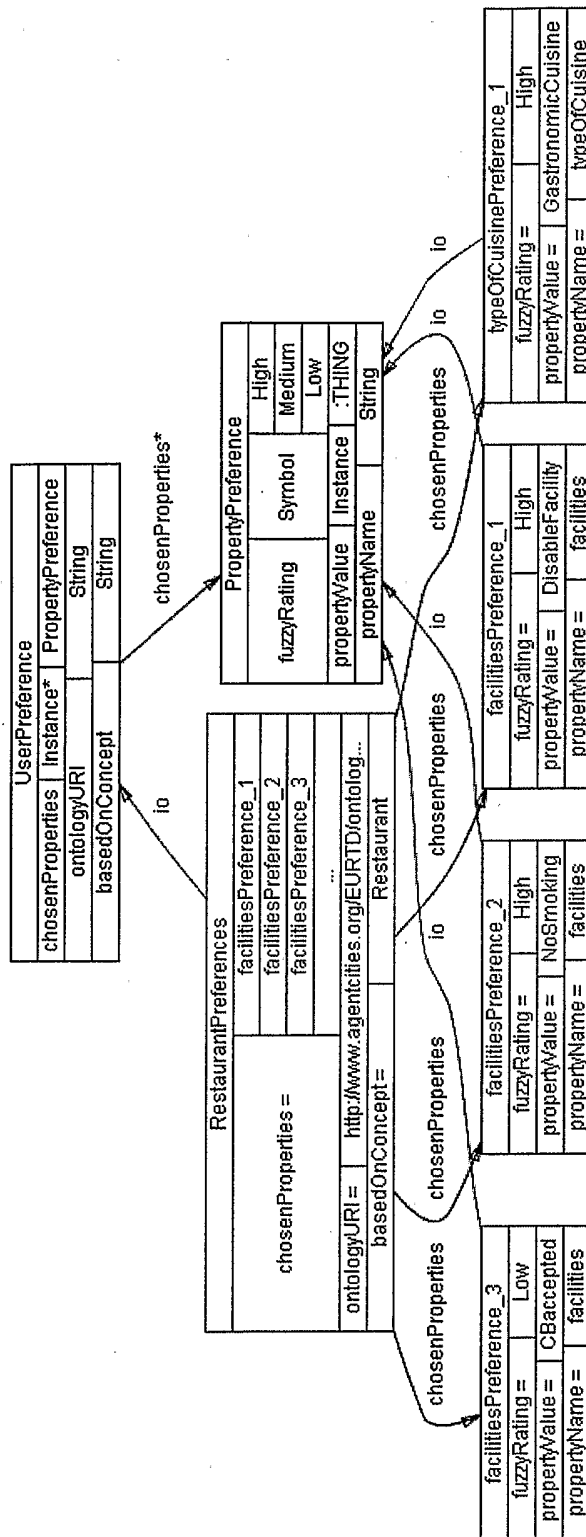
FIG. 1

100

UserPreference		
basedOnConcept		String
chosenProperties	Instance*	PropertyPreference
ontologyURI		String

chosenProperties*

PropertyPreference		
propertyValue	Instance	:THING
propertyName		String
fuzzyRating	Symbol	High
		Medium
		Low

FIG. 2

FIG. 3