ID-WSF Interaction Service

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Abstract:

It is often necessary for providers of identity services to interact with the owner of the exposed resources. Typically, such a resource owner is not visiting the identity service provider but some other party, known as a web service consumer. The web service consumer invokes a service at the identity service provider. This specification describes how the identity service provider and web service consumer can cooperate to redirect the resource owner to the identity service provider. In addition an Interaction Service is specified; this is an identity service that allows providers to pose simple questions to a Principal. This service can be offered by trusted web service consumers as well as by a dedicated provider that has a reliable means of communication with the Principal.

Notice

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Revision History

Revision: 0.2 **Date:** 11 February 2003

Minor improvements after Miami meeting. Now with WSDL attached. Changed filename to convention.

Revision: 0.3 **Date:** 14 March 2003

Name changed. Numerous improvements in the readability of the text. UserInteraction header improved. Started to include security issues. Included proposals for Bugzilla issues: 62, 63, 72, 82, and partly 71

Revision: 0.4 **Date:** 14 March 2003

Corrected many minor typos, formats, etc. after fast review by Jukka. Expanded security texts a tiny bit.

Revision: 0.5 **Date:** 4 April 2003

Corrected many minor typos etc. Improved signed inquiry. Corrected schema. Overhaul of Inquiry element to align better with XForms and provide better support for signed InteractionStatements. Addresses Bugzilla issues 81, 103, 166, 167,168, 169

Revision: 0.6 **Date:** 11 April 2003

Added figures. Added QName to restrict interactions to policy inquiries. Reworked to remove (references to) Request and Response. Added status (error) codes for UserInteraction header. Addresses Bugzilla issues 73, 81, 207, 216, 217, 218, 219, 220.

Contents

1. Notation and Conventions

This specification uses schema documents conforming to W3C XML Schema (see [Schema1]) and normative text to describe the syntax and semantics of XML-encoded messages.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119.

These keywords are thus capitalized when used to unambiguously specify requirements over protocol and application features and behavior that affect the interoperability and security of implementations. When these words are not capitalized, they are meant in their natural-language sense.

The following namespaces are referred to in this document *(these are still very inconsistent and also incomplete!)*:

- The prefix `is:` stands for the ID-WSF working namespace for the Interaction Service (urn:liberty:is:1.0). This namespace is the default for instance fragments, type names, and element names in this document.
- The prefix `dsc:` stands for the ID-WSF working namespace for the Discovery Service (urn:liberty:wsf:disco:1.0).
- The prefix `sb:` stands for the ID-WSF working namespace for the ID-WSF SOAP Binding (urn:liberty:wsf:1.0).
- The prefix `S:` stands for the SOAP 1.1 namespace.
- The prefix `wsdl:` stands for the primary WSDL namespace (http://schemas.xmlsoap.org/wsdl/).
- The prefix `xs:` stands for the W3C XML schema namespace (http://www.w3.org/2001/XMLSchema).
- The prefix `xsi:` stands for the W3C XML schema instance namespace (http://www.w3.org/2001/XMLSchema-instance).

2. Overview

An *identity* service may sometimes need to interact with the owner of the *resource* that it is exposing, for example to collect attribute values, or to obtain permission to share the data with a *WebService Consumer* (abbr. WSC). The Interaction Service (abbr. IS) specification defines schemas and profiles that enable a *WebService Provider* (abbr. WSP) to interact with the owner of a resource that is exposed by that WSP. Note that at the time of invocation of the WSP by a WSC various situations are possible. At best the *resource owner* has a browser session with the invoking WSC, i.e. the WSC acts as *Service Provider* toward the user. At the other extreme a WSP may need to obtain some information from the resource owner when the resource owner is not browsing at all, e.g. when an invoice needs to be authorized, or the WSP is invoked because another party (perhaps a friend or family member) is using the WSC.

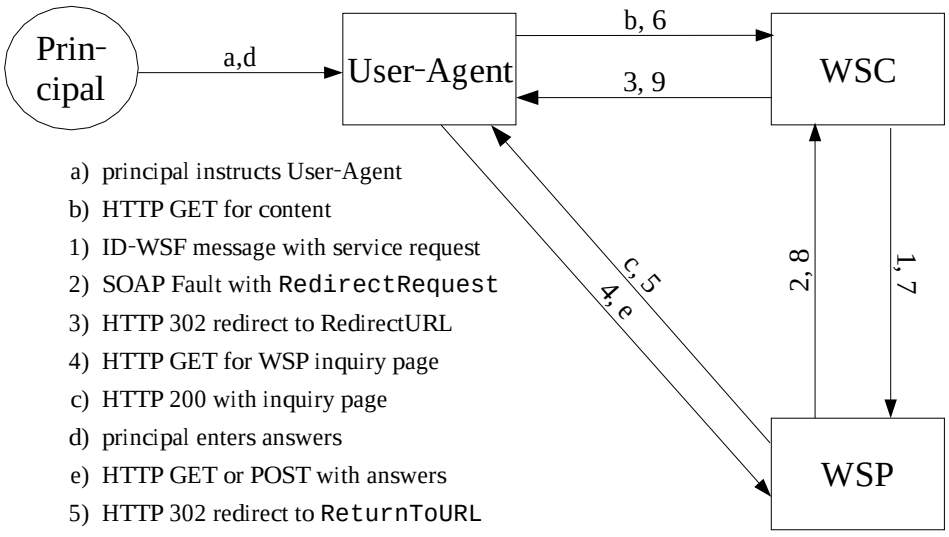
Note:

Note that the user browsing at a SP that invokes a WSP is not necessarily the owner of the resource at that WSP. However, the first version of the ID-WSF assumes that the user of the browser and the resource owner are the same Principal. Nevertheless, this specification should be prepared for cases when the user and resource-owner identify different Principals.

For the case when the resource owner is visiting (where *visiting* is short for having used a HTTP User Agent to send a HTTP request to) the WSC there are three possibilities for the WSP to contact the resource owner; the last method works for all other cases too:

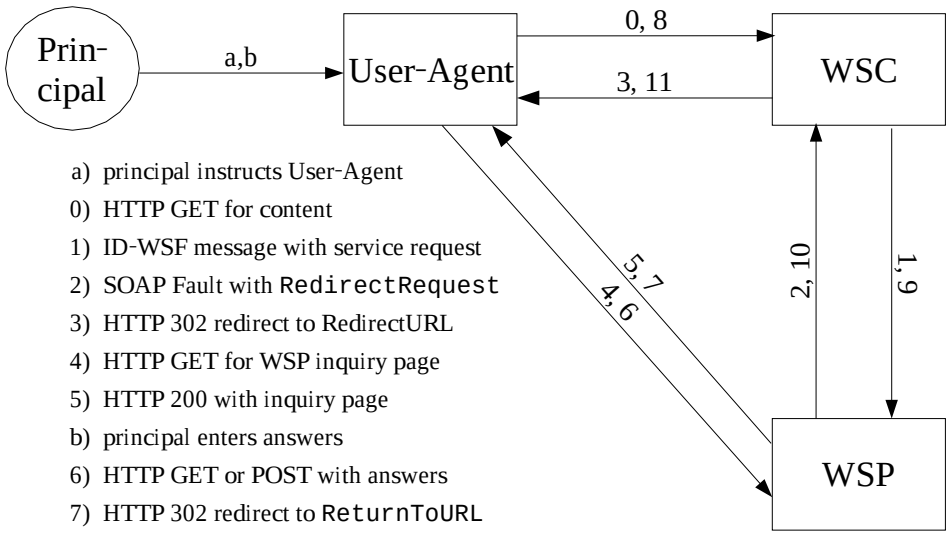
1. The WSC can indicate in the invocation message to the WSP that the resource owner is visiting the WSC and that it is ready to redirect the resource owner to the WSP. The WSP could then in its response ask the WSC to redirect the user (User Agent) to itself (the WSP). This will cause the resource owner to visit the WSP and hence the WSP can pose some questions. Once the WSP has obtained the information it needed it can redirect the user back to the WSC. The WSC can now re-invoke the WSP that now should be able to serve the request without any further interaction.

Figure 1. WSP interacts with Principal by requesting the WSC to redirect the user-agent. Numbered messages refer to the steps of the RedirectRequest profile.



2. The WSC can indicate in the invocation message to the WSP that the resource owner is visiting the WSC and that it is ready to present questions to the visiting resource owner. The WSC effectively offers an *Interaction Service* (abbrev. IS) to the WSP. The WSP could invoke that service with a well-defined message that specifies the questions that it wants the WSC to pose to the user. The WSC would obtain the answers and then respond to the WSP. The WSP now has the information it needs and can respond to the originating invocation from the WSC. In this scenario the WSP needs to trust the WSC to act as proxy for the resource owner. Similarly, the resource owner needs to trust the WSC in its role as Interaction Service. The IS is almost literally a "man in the middle".

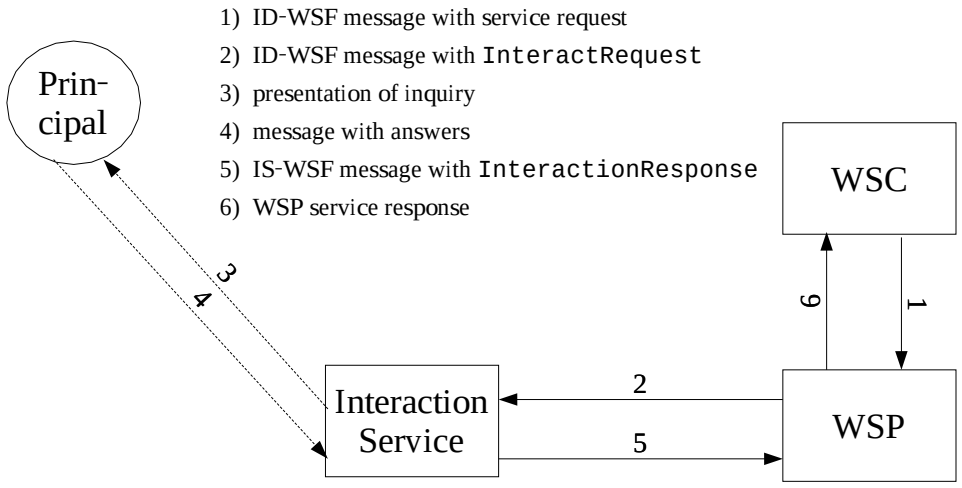
Figure 2. WSP interacts with Principal by requesting the WSC to pose an inquiry.



a) principal instructs User-Agent
0) HTTP GET for content
1) ID-WSF message with service request
2) SOAP Fault with `RedirectRequest`
3) HTTP 302 redirect to RedirectURL
4) HTTP GET for WSP inquiry page
5) HTTP 200 with inquiry page
b) principal enters answers
6) HTTP GET or POST with answers
7) HTTP 302 redirect to `ReturnToURL`
8) HTTP GET for `ReturnToURL`
9) reissue of ID-WSF message with service request
10) WSP service response
11) HTTP 200 with content

3. The WSP can check from a *Discovery Service* if there is a (permanent) *Interaction Service* available for the resource owner. Such an Interaction Service is, by definition, capable of interaction with the Principal at any time; for example by using special protocols, mechanism and channels such as instant messaging, WAP Push, etc. If such an Interaction Service (IS) is available, the WSP can invoke that IS, again with a well-defined message that specifies the questions that it wants the IS to pose to the user. The IS would obtain the answers and then respond to the WSP. The WSP now has the information it needs and can respond to the originating invocation from the WSC. In this scenario the WSP and resource owner again need to trust the IS to act as proxy.

Figure 3. WSP interacts with Principal by requesting the Interaction Service to pose an inquiry.



It is also possible that a WSC wishes to prevent a WSP from interacting with the resource owner, independent of the interaction method. This for example to provide a non-disrupted user experience. So the WSC would prefer to receive an error from the WSP over the chance that the user would get prompted. Alternatively, a WSC may need the service from the WSP badly and wants to encourage the WSP to engage in those resource owner interactions that are required in order to satisfy the request.

To enable all of the above the remainder of this document specifies:

- An element for a WSC to indicate its preferences and capabilities for interactions with the resource owner, and processing rules for that element.
- A profile that enables the WSC and WSP to cooperate in redirecting the resource owner to the WSP and back to the WSC.
- Elements, processing rules and WSDL that together define an identity based Interaction Service, that can be made available temporarily by the WSC, or offered on a more permanent basis by a party that has the necessary permanent channel to the Principal.

3. The `UserInteraction` element

A Web Service Consumer that interacts with a user (typically through a web-site offered by the WSC) may need to indicate its readiness to redirect the user agent of the user, or its readiness to pose questions to the user on behalf of other parties (such as WSPs). To this end ID-WSF messages (see ID-WSF Messages) MAY include a `<UserInteraction>` (as a SOAP header). This element controls the possibilities that Web Service providers have to engage in resource owner interactions when serving a request from a WSC. It contains:

- An optional `InteractionService` element that indicates that the sender can process messages defined for the Interaction Service.
- An optional `interact` attribute to indicate the preference that the sender has about interactions between the receiver and the resource owner. The value is a QName; this specification defines the values:
  - `is:interactIfNeeded` to indicate to the recipient that it should interact with the resource owner if needed to satisfy the ID-WSF request. This is the default.
  - `is:doNotInteract` to indicate to the recipient that it MUST NOT interact with the resource owner. The sender prefers to receive an error response over the situation where the resource owner would be distracted by an interaction.
  - `is:doNotInteractForData` to indicate to the recipient that it MAY interact with the resource owner *only* if an explicit policy for the offered service so requires. The sender prefers to receive an error response over the situation where the WSP would obtain service response data (e.g. Personal Profile data) from the resource owner, but the sender does prefer to obtain a positive service response even if that requires policy-related interaction for e.g. obtaining consent.

  Implementors may choose to define additional QNames to indicate finer grained control over the user interactions.
- An optional `language` attribute that indicates the languages that the user likely is able to process. Tha value of this attribute is a space separated list of Language Identification Tags. The WSC can obtain this information from the HTTP Accept-Language header, or by other means, for example from a *Personal Profile service*.
- An optional `redirect` attribute to indicate that the sender supports the `<RedirectRequest>` element a WSP may include in a message to the WSC. The value is `"true"` or `"false"`. When absent the default behavior will be as if `"false"`.
- The optional `maxInteractTime` attribute to indicate the maximum time in seconds that the sender regards as reasonable any possible interaction. The receiver is not expected to start any interaction if it has reason to assume that such interaction is likely to take more time. In case an interaction is started and does seem to take longer the receiver is expected to respond with a message that contains a `is:timeout` status code to the sender.
- The optional SOAP `actor` attribute. Only used when the element is used in a `<S:Header>`.
- The optional SOAP `mustUnderstand` attribute. Only used when the element is used in a `<S:Header>`.

The schema fragment for the `UserInteraction` element is:

```
<element name="UserInteraction" type="is:UserInteractionHeaderType"/>
<complexType name="UserInteractionHeaderType">
   <complexContent>
      <element name="InteractionService"
            type="dsc:ServiceInstanceType"
            minOccurs="0" maxOccurs="1"/>
      <attribute name="interact" type="QName" use="optional" default="lib:interactIfNeeded"/>
      <attribute name="language" type="NMTOKENS" use="optional"/>
      <attribute name="redirect" type="boolean" use="optional" default="0"/>
      <attribute name="maxInteractTime" type="integer" use="optional"/>
      <attribute ref="S:actor" use="optional"/>
      <attribute ref="S:mustUnderstand" use="optional"/>
   </complexContent>
</complexType>
```

Below is an example for a WSC that is prepared to redirect the user to a WSP, and also is ready to accept an `<is:InteractionRequest>`. The WSC wishes that the WSP will not attempt to prompt the resource owner for missing data; but accepts interactions for consent, as long as questioning the user will not take more than 60 seconds. The WSC expects the user to understand English and Finnish.

```
<UserInteraction interact="is:doNotInteractForData" language="en-US fi" maxInteractTime="60" redirect=”1”>
   <InteractionService xmlns:dsc="urn:liberty:dsc">
      <dsc:ServiceType>liberty:wsf:is:1.0</dsc:ServiceType>
      <dsc:Provider>http://someWSC</dsc:Provider>
      <dsc:Description>
         <dsc:Endpoint>http://someWSC/soap</dsc:Endpoint>
      </dsc:Description>
   </InteractionService>
</UserInteraction>
```

Next is an example for a WSC that wants to ensure that the WSP will not attempt to contact the resource owner, even if this may hinder serving the actual request; the WSC rather receives an error, or less optimal response (e.g. fewer profile attributes).

```
<UserInteraction interact="is:doNotInteract"/>
```

3.1. Processing Rules

If the sender sets `interact="is:doNotInteract"` it MUST omit the `InteractionService` element, as well as the `language`, `redirect` and `maxInteractTime` attributes.

The recipient of a message with a `UserInteraction` element MUST NOT respond with a `<is:RedirectRequest>` if the `<redirect>` is `<"false">` or if `<redirect>` is absent.

The recipient MUST NOT send a `<InteractionRequest>` if the `<UserInteraction>` does not contain an `InteractionService` element.

The recipient MUST NOT start a resource owner interaction if the `interact` attribute has a value of `"is:doNotInteract"`.

The recipient MUST NOT interact with the resource owner to obtain data that is to be included in a successful service response if the `interact` attribute has a value of `"is:doNotInteractForData"`. In this case the recipient MAY start an interaction if a policy concerning available data so requires; for example if a policy requires that the Principal must be prompted for consent.

The recipient SHOULD NOT start a resource owner interaction if it expects that the time to complete the interaction will exceed the value of the `maxInteractTime`.

The recipient MUST respond to the message after at most the number of seconds given as the value of the `maxInteractTime` attribute.

3.1.1. UserInteraction Faults

A processor of a `UserInteraction` that must indicate an error situation related to this header SHOULD respond to the sender with an ID-WSF message that contains a `Status` element in: a `S:Details` element of a`S:Fault`, or in a service specific `S:Body` component, or inside a higher level `Status`element. The `code` attribute of the included `Status` element can be set to one of the following values:

- `is:interactionRequired`, as indication that the recipient has a need to start an interaction in order to satisfy the service request but the `interact` attribute value was set to `is:doNotInteract`.
- `is:forData`. This indicates that the service request could not be satisfied because the WSP would have to interact with the resource owner in order to obtain (some of) the requested data but the `interact` attribute value was set to `is:doNotInteractForData`.
- `is:timeNotSufficient`, as indication that the recipient has a need to start an interaction but has reason to believe that more time is needed that allowed for by the value of the `maxInteractTime` attribute.
- `is:timeout`, as indication that the recipient could not satisfy the service request due to an unfinished interaction.

4. The RedirectRequest protocol

In the RedirectRequest profile the WSP requests the WSC to redirect the user-agent of the Principal to a resource (URL) at the WSP. Once the user-agent issues the HTTP request to fetch the URL the WSP has the opportunity to present one or more pages with questions and other information to the Principal. When the WSP has obtained the information that it required (in order to serve the WSC) it redirects the user-agent back to the WSC. The WSC can now re-issue its request to the WSP (see Figure 1).

4.1. The RedirectRequest element

The RedirectRequest element instructs the WSC to redirect the user to the WSP. It is an indication of the WSP that it cannot service a request made by the WSC before it obtains some more information of the resource owner. The element is typically present in the S:Detail element within a <soap:Fault>. The <RedirectRequest> has one attribute:

- redirectURL, the URL to which the WSC should redirect the user-agent. This URL MUST NOT contain parameters named ReturnToURL or IDP as these are reserved for the recipient of the <RedirectRequest> (see the RedirectRequest profile). The URL SHOULD start with https: to ensure the establishment of a secure connection between the user-agent and the WSP.

The optional text content of the element can be used to indicate the reason for the need for interaction with the resource owner.The schema fragment for the element is:

```
<element name="RedirectRequest" type="RedirectRequestType"/>
<complexType name="RedirectRequestType">
   <attribute name="redirectURL" type="anyURI" use="required"/>
</complexType>
```

An example of a <RedirectRequest> in a SOAP Fault could look like:

```
<S:Envelope xmlns:S="http://schemas.xmlsoap.org/soap/envelope/>
   <Header>
      <wsf:Response xmlns:wsb="urn:liberty:wsf:1.0" inResponseTo="13ef36ac47da"/>
   </S:Header>
   <S:Body>
      <Fault>
         <faultcode>SOAP-ENV:Server</faultcode>
         <faultstring>Server Error</faultstring>
         <Detail>
            <is:RedirectRequest
                  redirectURL="https://someWSP/getConsent?transID=de67hj89jk65nk34">
               Redirecting to AP to obtain consent
            </is:RedirectRequest>
         <Detail>
      </S:Fault>
   </S:Body>
</S:Envelope>
```

4.1.1. Processing Rules

The recipient of a <RedirectRequest> MUST verify that the redirectURL points to the WSP, i.e. the host in the URL should be the same as the host to which the WSC sent its service request. If this is not the case the recipient MUST ignore the <RedirectRequest>.

The recipient MUST attempt to direct the user-agent to issue an HTTP request for the URL in the redirectURL attribute of the <RedirectRequest>. That user agent MUST be associated with the ID-WSF request that caused the <RedirectRequest>. The recipient MUST add a ReturnToURL parameter to the redirectURL with as value the URL-encoded URL to which the recipient wants the user-agent directed back. It is recommended that this ReturnToURL includes an identifier that associates the URL to the originating ID-WSF message to the WSP. The

recipient MAY add an `IDP` parameter to the `redirectURL` with as its value the `providerID` of an identity provider that was used to authenticate the user to the WSC. Inclusion of this parameter is likely to prevent the WSP from having to do *Identity Provider Introduction* as specified in ID-FF Profiles and Bindings.

The recipient may instruct the user-agent to submit either an HTTP GET or an HTTP POST request to the URL; in this way the WSC can avoid problems with user-agents that can handle only short URLs. If the user-agent is instructed to submit a HTTP POST *all* URL parameters should be form-encoded, and the HTTP content-type header of the request MUST be `application/x-www-form-urlencoded`. Note that this implies that the WSP SHOULD accept both an HTTP GET as well as an HTTP POST request for the `redirectURL`, but in either case retrieval of URL parameters can be done using well-known techniques; most HTTP server environments effectively encapsulate the different methods for submission of parameters.

For example, assume that a Principal would visit a service provider. As a result the service provider (acting as WSC) could have made a request to a WSP, and that WSP would have responded with the SOAP Fault of the example above. The WSC would now send a HTTP response to the user agent that would look like:

```
HTTP 302
Location: https://someWSP/getConsent?transID=de67hj89jk65nk34&ReturnToURL=https%3a%2f%2fsomeWSC%2
                    fisReturn%3bjsession%3d9A6F2E3A&IDP=1A2B3C4D5E1A2B3C4D5E
...
other HTTP headers
...

<html>
   <head>
      <title>Redirecting...</title>
   </head>
   <body>
      <p>Redirecting to AP to obtain consent</p>
   </body>
</html>
```

4.2. Profile

The profile for a `<RedirectRequest>` consists of the following steps, each with normative rules (see also Figure 1):

4.2.1. Step 1: WSC issues normal ID-WSF request

For the `<RedirectRequest>` profile to be initiated the originating ID-WSF message MUST contain a `UserInteraction` element with its `redirect` attribute set to `"true"`.

4.2.2. Step 2: WSP responds with `<RedirectRequest>`

If, and only if, an ID-WSF message contains a `UserInteraction` element with its `redirect` attribute set to `"true"` MAY the recipient of the ID-WSF message respond with a `<RedirectRequest>`.

Note:

The `redirectURL` attribute must be constructed as to include the necessary information for mapping the upcoming HTTP request to the originating ID-WSF message; for example by inclusion of the value of the `messageID` or `refToMessageID` attribute of a `sb:Correlation` element.

4.2.3. Step 3: WSC instructs User Agent to contact the WSP

When the WSC receives a `<RedirectRequest>` it MUST attempt to direct the user-agent to issue an HTTP request for the URL in the `redirectURL` attribute of the the `RedirectRequest`. The user agent MUST be associated with the ID-WSF message that caused the `<RedirectRequest>`. The WSC MUST append a `ReturnToURL` parameter to the `redirectURL` with as value the URL-encoded URL to which the WSC wants the user-agent directed back.

It is recommended that this `ReturnToURL` includes an identifier that associates the URL to the originating ID-WSF message (of step 1).

Note:

The actual realization of this step is dependent on the user-agent. In most cases this is accomplished by a simple HTTP 302 response with a `<Location>` header set to the `redirectURL`. Different user-agents may be better served by other approaches, for example a WML browser may be able to handle a redirect deck better than a potentially long URL. See the processing rules for the `<RedirectRequest>`.

4.2.4. Step 4: WSP interacts with User Agent

In step 4 the user agent issues the HTTP request for the `redirectURL`, appended with the `ReturnToURL` parameter, and optionally with the `IDP` parameter. The WSP MUST verify that the `ReturnToURL` points to the WSC, i.e. the host in the URL should be the same as the host to which the WSP sent the `<RedirectRequest>`. If this is not the case the WSP MUST ignore the `ReturnToURL`, abort the profile, and construct a meaningful error message for the user. But otherwise the service (WSP) MAY now proceed with a HTTP response that contains an inquiry directed at the user. The WSP SHOULD verify that the identity of the user is indeed the owner of the resource that was targeted in the originating ID-WSF request, for example by means of a `<lib:AuthnRequest>` (see ID-FF Protocols and Schemas). This Step 4 may be followed by any number of interactions between the user and the WSP, but the WSP should attempt to execute step 5 within a reasonable time.

4.2.5. Step 5: WSP redirects User Agent back to WSC

In step 5 the WSP that issued the `<RedirectRequest>` MUST attempt to instruct the user-agent to issue an HTTP request for the `ReturnToURL` that was included as parameter on the URL of the HTTP request made in step 4. The WSP SHOULD append a `ResendMessage` parameter to the `ReturnToURL`. This parameter serves as a hint to the WSC about the next step. A value of `0` or `false` indicates that the WSC should not try to re-issue the originating ID-WSF request, presumably because the resource owner did not approve to complete the transaction. If the value of `ResendMessage` is `true`, `1`, or any string other than `0` or `false`, it is an indication that the WSP recommends the WSC to re-issue the originating request. It is RECOMMENDED that in a positive case the value of this parameter is set to the `messageID` of the `<sb:Correlation>`element of the originating ID-WSF message.

4.2.6. Step 6: User-Agent requests `ReturnToURL` from WSC

In step 6 the user agent requests the `ReturnToURL` from the WSC. The WSC SHOULD check the value of the `ResendMessage` parameter; if the value is `0` or `false` the WSC SHOULD NOT send an ID-WSF message with a request for the same resource and/or action (as in step 1). If the value of the `ResendMessage` parameter is anything else the WSC MAY resend the message (Step 7). If the WSC resend its request it MUST set the `refToMessageID` attribute of the `<sb:Correlation>` SOAP header to the value of the `messageID` of the `<sb:Correlation>` that accompanied the `<RedirectRequest>` (in step 2).

Finally, typically after receiving the response from the WSP, the WSC has to respond with a HTTP response to the user agent.

4.2.7. Step 7: WSC resends message

The WSC that resend its request it MUST set the `refToMessageID` attribute of the `<sb:Correlation>` SOAP header block to the value of the `messageID` of the `<sb:Correlation>` that accompanied the `<RedirectRequest>` (in step 2).

4.2.8. Steps 8 & 9: completing outstanding requests.

Finally, after receiving the response from the WSP (step 8), the WSC has to respond with a HTTP response to the user agent (step 9).

5. Interaction Service

The Interaction Service (abbr. IS) is an ID-WSF service that exposes a means for simple interaction of an ID-WSF participant with a Principal. It allows clients (typically WSPs, that act toward the IS service as WSC!) to query a Principal for consent, authorization decisions, etc. An IS provider accepts request to present some information and questions to a Principal. The IS provider is responsible for "rendering" a "form" to the Principal. It is expected that the IS provider knows about the capability of the Principals device and about the preferences of the Principal. The IS returns the answer(s) of the Principal in a response that contains the values for the parameters of the request.

The service type URN for the Interaction Service is `urn:liberty:is:1.0`.

Although an Interaction Service may exist as an identity service that is registered with the Discovery Service, the Interaction Service MAY also (or solely) be provided by a web service consumer that is invoking an identity service, but only when that service provider is engaged in an interactive session with the Principal. However, the consumer of such an IS must have great trust in the IS provider as the consumer has no means of asserting that the response indeed is based upon resource owner input. However, record keeping by all parties will support resolution of any possible dispute about a breach of such trust.

Only a party that is in principle capable of contacting the Principal *any time* should register as `urn:liberty:is:1.0` with the Discovery Service of that Principal.

An example deployment of a permanent IS provider could consist of an IS interface on top of a standard WAP Push service. The IS could accept `<InteractionRequest>`s and create WML pages from such requests. It then sends a WAP Push message to the Principals device with a temporary URL, that points to the newly created page. Once the WAP client receives the WAP message it will launch a HTTP session and fetches the given URL. The HTTP response will contain the WML page, which will be rendered in a browser on the client. The user would answer the question(s) in the form and submit it. The IS would now send a `<InteractionResponse>` to the invoker (and a "Thank You" page to the Principal). Note that this is just an example; another implementation could use an instant messaging protocol and yet another implementation could do both and switch based upon the users presence information (that it obtains from possibly yet another identity service).

5.1. Interaction Request

A provider that wants to query a Principal sends an `<InteractionRequest>`. This element allows for the sender to define several types of queries. The requester can define text labels, parameters and default values. The response will have values for the parameters. The requester SHOULD NOT assume any particular final format of the query. The encompassing ID-WSF request MUST NOT contain a `<UserInteraction>` element.

5.1.1. The `InteractionRequest` element

The `InteractionRequest` element allows to requester to define a "form" that the IS will try to present to the Principal. It contains:

- The required `Resource` element that identifies the resource owner. The sender may use the Discovery Service to obtain the value for the `<Resource>`. For client or WSC hosted Interaction Services the value of this element MUST be set to `urn:liberty:wsf:implied-resource`.
- The required `Inquiry` element contains the elements that make up the actual query. There may be more than one `<Inquiry>` but it is RECOMMENDED that an `<InteractionRequest>` contains only one `<Inquiry>`. See the note on chaining for a reason for allowing more than one `<Inquiry>`.

- The optional `ds:KeyInfo` element can contain a public signing key that the sender has for the Principal. Presence of this element indicates to the IS that the sender wishes that the Principal signs the response with the associated private key and that the IS should include the signed statement in its response. If this element is present the `signed` attribute MUST be present too.

- The optional `signed` attribute indicates that the sender wishes for the Principal to sign the response.The value of this attribute can be `"strict"`, or `"lax"`. A value of `"strict"` indicates that the sender wants a positive response only if it will contain a signed statement from the Principal. It this attribute is present a `<ds:Keyinfo>` MAY be present too, and the `<InteractionRequest>` SHOULD NOT contain more than one `<Inquiry>`.

- The optional `maxInteractTime` attribute to indicate the maximum time in seconds that the sender regards as reasonable for the resource owner interaction. A WSP MUST NOT set the value of this attribute to a greater value than the value of a possibly received `maxInteractTime` attribute in a `UserInteraction` element.

The schema fragment for the `<InteractionRequest>` is:

```
<element name="InteractionRequest" type="is:InteractionRequestType" />
<complexType name="InteractionRequestType">
   <sequence>
      <element ref="Resource" minOccurs="1" maxOccurs="1" />
      <element ref="is:Inquiry" minOccurs="1" maxOccurs="unbounded" />
      <element ref="ds:KeyInfo" minOccurs="0" maxOccurs="1"/>
   </sequence>
   <attribute name="maxInteractTime" type="integer" use="optional" />
   <attribute name="signed" type="token" use="optional"/>
</complexType>
```

5.1.2. The `Inquiry` element

The `Inquiry` element contains:

- an optional `Help` element.

- one or more elements that are of type `InquiryElementType`.

- an optional `id` attribute. The `id` attribute MUST be present if the encompassing `<InteractionRequest>` contains the`signed` attribute and then its value MUST have the properties of a nonce.

- an optional `title` attribute. The Interaction Service SHOULD present the value of the `title` attribute in accordance with the conventions of the agent used to present the inquiry to the Principal.

The schema fragment for the <Inquiry> is:

```
<element name="Inquiry" type="is:InquiryType" />
<complexType name="InquiryType">
   <sequence>
      <element ref="is:Help" minOccurs="0" maxOccurs="1" />
      <element ref="is:Select" minOccurs="0" maxOccurs="unbounded" />
      <element name="Confirm" type="is:InquiryElementType" minOccurs="0" maxOccurs="unbounded" />
      <element ref="is:Text" minOccurs="0" maxOccurs="unbounded" />
   </sequence>
   <attribute name="id" type="xs:ID" use="optional" />
   <attribute name="title" type="string" use="optional" />
</complexType>
```

The Help element contains informal text about its parent element. Whitespace in this element is significant in that the IS provider is expected to attempt to respect newline characters. The IS provider is not expected to render the text of this element, but rather provide the Principal with an option to view the text. The IS provider is expected to realize such option according to the conventions of the user agent of the Principal. Apart from the help text this element may have:

- An optional label attribute.
- An optional link attribute which value MUST be a resolvable URL to information about the parent element. If the link attribute is present then the Help element MUST NOT contain text.
- An optional moreLink attribute which value MUST be a resolvable URL to *additional* information about the parent element. The IS provider is expected to present the Principal with an appropriate means (e.g. a button, link, menu item, etc.) for obtaining this additional info.

The schema fragment for the Help element is:

```
<element name="Help" type="is:HelpType" />
<complexType name="HelpType" mixed="true">
   <attribute name="label" type="string" use="optional" />
   <attribute name="link" type="anyURI" use="optional" />
   <attribute name="moreLink" type="anyURI" use="optional" />
</complexType>
```

A <Hint> contains short informal text about its parent element. The IS provider is expected to render the text of this element as a hint, according to the conventions of the user agent of the Principal. The simple Hint element does not contain attributes or children elements.

The InquiryElementType is an abstract type that defines the common content for query elements. The type contains:

- an optional Help element
- an optional Hint element.
- an optional Label element. An IS provider is expected to render the content of Label elements. Note that the text value of a <Label> is normalized.

- an optional `Value` element. Where applicable an IS provider will render the content of `Value` elements, as initial value for the parameter (as default). Requesters that wish to receive a signed `Statement` in the response MUST include a (possibly empty) `<Value>` for each instance of `InquiryElementType`. Note that the text value of a `<Value>` is normalized.

- The required `name` attribute. Note that a single `<InteractionRequest>` may not contain more than one `<InquiryElement>` with the same name, as the `type;` of this attribute is `xs:ID`. The `name` attribute is used as a parameter name. The `name` attribute will not be rendered by the IS service, but in case there is no `<Label>` provided the InteractionService MAY render the value of the `name` attribute.

The schema fragment for the `InquiryElementType` is:

```
<complexType name="InquiryElementType" abstract="true">
   <sequence>
      <element ref="is:Help" minOccurs="0"/>
       <element ref="is:Hint" minOccurs="0"/>
       <element name="Label" type="xs:normalizedString" minOccurs="0"/>
       <element name="Value" type="xs:normalizedString" minOccurs="0"/>
   </sequence>
   <attribute name="name" type="xs:ID" use="required"/>
</complexType>
<element name="Hint" type="xs:string" />
```

The defined `<InquiryElementType>` subtypes are:

- The `Select` element. This element allows the requester to ask the resource owner to select one (or more) items out of a given set of values. The resulting parameter value is a string with space separated tokens. This element contains `Item` elements that contain label and value *attributes* . The content of the optional `<Value>` MUST match the `value` of one of the children `Item` elements. The `Select` element has a boolean `multiple` attribute to indicate if more than one item can be selected; the default is `"false"`.
  The schema fragment for the `Select` element is:

```
<element name="Select" type="is:SelectType"/>
<complexType name="SelectType">
   <complexContent>
      <extension base="is:InquiryElementType">
         <sequence>
            <element name="Item" minOccurs="2" maxOccurs="unbounded">
               <complexType>
                  <sequence>
                     <element ref="is:Hint" minOccurs="0" />
                  </sequence>
                  <attribute name="label" type="xs:string" use="optional" />
                  <attribute name="value" type="xs:NMTOKEN" use="required" />
               </complexType>
            </element>
         </sequence>
         <attribute name="multiple" type="xs:boolean" default="false" use="optional"/>
      </extension>
   </complexContent>
</complexType>
```

- The `Confirm` element. This element allows the requester to ask the resource owner a yes/no question. The resulting parameter value is `"true"` or `"false"`.

- The `Text` element. This element allows the requester to ask the resource owner an open ended question. The requester may give a recommended minimum and maximum size in characters, as well as a format input mask. The resulting parameter value is a text string.
  The format string SHOULD adhere to the specification for format input masks for WML 1.3 `input` elements. However note that it is the Interaction Service that SHOULD attempt to obtain a `value` for the `Text` element that matches with the requested format input mask. It is up to the recipient of the `<InteractionResponse>` to verify the format of values as an Interaction Service MAY ignore a `format` attribute.The format input mask may help speed up entry of the value by the Principal.
  The schema fragment for the `Text` element is:
  D1

```
<element name="Text" type="is:TextType"/>
<complexType name="TextType">
   <complexContent>
      <extension base="is:InquiryElementType">
         <attribute name="minChars" type="xs:integer" use="optional"/>
         <attribute name="maxChars" type="xs:integer" use="optional"/>
         <attribute name="format" type="CDATA" use="optional"/>
      </extension>
   </complexContent>
</complexType>
```

5.1.3. Example request

An example for a query that asks for consent to share the owner's address with a WSC could look like:

```
<InteractionRequest xmlns="urn:liberty:is:1.0">
   <Resource>data:d8ddw6dd7m28v628</Resource>
   <Inquiry title="Profile Provider Question">
      <Help moreLink="http://pip.example.com/help/attribute/read/consent"> example.com is requesting your address.  We do not<
have a rule that instructs us how you want us to process this request.  Please pick one of the given options.  Note that the last<
two options do prevent you from being prompted this question when example.com asks for your address again.
      </Help>
      <Select name="address-choice">
         <Label>Do you want to share your address with service-provider.com?</Label>
         <Value>no</Value>
         <Item label="Not this time" value="no" />
         <Item label="Yes, once" value="yes"/>
         <Item label="No, never" value="never">
            <Hint>We won't give your address and don't ask again</Hint>
         </Item>
         <Item label="Yes, always" value="always">
            <Hint>We will share your address now and in the future</Hint>
         </Item
      </Select>
   </Inquiry>
</InteractionRequest>
```

5.1.4. Processing rules

The recipient of an `<InteractionRequest>` MUST pose the first `<Inquiry>` to the `<wsf:Resource>`. The recipient MUST NOT pose any `<Inquiry>` if the `<InteractionRequest>` has a `<maxInteractTime>` attribute with a value smaller than the time that the recipient *expects* to be required to process that `<Inquiry>`. The recipient MAY pose *all* the `inquiry` elements, if it is able to do so in a manner that is both efficient as well as user friendly.

The recipient SHOULD make every attempt to format each `<Inquiry>` according to the expectations defined for the `Inquiry` element and its children elements.

If the <InteractionRequest> includes a signed attribute then the recipient SHOULD attempt to obtain a signed <InteractionStatement> from the Principal. If the value of the signed attribute is "strict" the recipient MUST respond with an <InteractionResponse> that contains either an <InteractionStatement>, or a Status element with its code attribute set to is:notSigned. Further, if the <InteractionRequest> includes a ds:KeyInfo element then the recipient SHOULD attempt to obtain an <InteractionStatement> signed with the (private) key associated with the key described in the ds:KeyInfo element. In this case the recipient MUST verify that the signature was constructed with the indicated key and if this was not the case the response SHOULD include a is:keyNotUsed Status code.

The recipient MUST respond with a message, that contains a Status element. Upon success this element is contained in an <InteractionResponse> and the code attribute MUST be is:success. Upon failure

5.2. Interaction Response

The IS Service responds with an ID-WSF message that contains an InteractionResponse element. This element contains a Status element and, upon success, values for all the parameters in the query of the corresponding <InteractRequest>. The code attribute of the Status element can take one of the following QNames:

- is:success when the principal answered the query and the message contains an <InteractionResponse>.
- is:cancel when the principal canceled the query.
- is:notSigned when the request indicates signed="strict" but no signed statement could be obtained.
- is:keyNotUsed when the Principal signed the inquiry with a key other than indicated in the <ds:KeyInfo> of the request.
- is:timeout when the Principal did not answer the query in a timely manner, or the connection to the Principals user agent was lost.
- is:timeNotSufficient when the IS provider expects that the Principal cannot answer the inquiry within the maxInteractTime number of seconds; e.g. due to the fact that it takes more time to establish a connection with the device of the Principal.
- is:notConnected when the IS provider can currently not contact the Principal.

5.2.1. The InteractionResponse element

The InteractionResponse element contains a Status element and, upon success, either:

- Parameter elements for each element in the <Inquiry> that is of the InquiryElementType. Each <Parameter> MUST have its name attribute match the value of the name attribute of the corresponding InquiryElement.

or:

- a signed <InteractionStatement> that contains the posed Inquiry element(s) but with the Value elements set (or left blank) by the Principal.

The Parameter element has two attributes:

- a required `name` attribute with a value matching the value of the `name` attribute on the corresponding`InquiryElement`.

- a required `value` attribute with the value that was obtained from the resource owner, or was an unchanged default. For `<Select>` query elements the `value` may be a space separated list of `tokens`.

The `<InteractionStatement>` consists of:

- `Inquiry` element(s) but with the `Value` elements set (or left blank) by the Principal. The `<Inquiry>` in an `<InteractionStatement>` MUST include *all* the `InquiryElements` of the request; but other elements, such as `<Help>`, `<Hint>` and `<Item>`, MAY be omitted.

- a `ds:Signature` element that contains the signature over all `Inquiry` elements. The signature must be constructed by use of the private key associated with the content of the `<ds:KeyInfo>` of the `<InteractionRequest>`.

The schema fragment for the `<InteractionResponse>`element is:

```
<element name="InteractionResponse" type="is:InteractionResponseType"/>
<complexType name="InteractionResponseType">
   <sequence>
      <element ref="is:Status" />
      <choice>
         <element name="InteractionStatement" type="is:InteractionStatementType" minOccurs="0"/>
         <element name="Parameter" type="is:ParameterType" minOccurs="0" maxOccurs="unbounded"/>
      </choice>
   </sequence>
</complexType>
<complexType name="InteractionStatementType">
   <sequence>
      <element ref="is:Inquiry" />
      <element ref="ds:Signature"/>
   </sequence>
</complexType>
<complexType name="ParameterType">
   <attribute name="name" type="xs:ID" use="required"/>
   <attribute name="value" type="xs:string" use="required"/>
</complexType>
```

An example of a response to the example request could look like:

```
<InteractionResponse>
   <Status code="is:success" />
   <Parameter name="address-choice" value="always" />
</InteractionResponse>
```

The same example as a response to an `<InteractionRequest>` with the `signed`attribute could look like:

```
<InteractionResponse>
   <Status code="is:success" />
   <InteractionStatement>
      <Inquiry title="Profile Provider Question" id="inquiry-3d4e2f8a37213b">
         <Select name="address-choice">
            <Label>Do you want to share your address with service-provider.com?</Label>
            <Value>always</Value>
         </Select>
      </Inquiry>
      <ds:Signature>
      ....
         <ds:Reference>#inquiry-3d4e2f8a37213b</ds:Reference>
       ....
      </ds:Signature>
```

```
   </InteractionStatement>
</InteractionResponse>
```

An example of an empty, unsuccessful, response to the example request could look like:

```
<InteractionResponse>
   <Status code="is:cancel" />
</InteractionResponse>
```

5.2.2. Processing rules

The recipient of an `<InteractionResponse>` that contains a signed `<InteractionStatement>` MUST verify the signature, and discard the response if the signature cannot be verified. That recipient MUST verify that the `id` attribute of the signed `<Inquiry>` corresponds with the `id` of the corresponding request `<Inquiry>`.

Note:

A WSP that is processing an ID-WSF request may choose to encapsulate a "real" IS in an attempt to combine possible `<InteractionRequest>`s into a single `<InteractionRequest>`. This situation may occur if the WSP is going to make one or more ID-WSF requests before it responds to the ID-WSF request that it received. Each of the "secondary" WSPs may have a need to interact with the resource owner. An example of such a WSP could be an Attribute Proxy. For a WSP that encapsulates an IS in this manner all the normative text for the Interaction Service applies. In addition it needs to implement some algorithm to combine the `InteractionRequest` elements. An extremely simple algorithm simply copies each `<Inquiry>` into a new `<InteractionRequest>`.

6. Security Considerations

The Interaction Service is effectively acting to its client WSCs as a proxy for the Principal. It is therefore important that the IS can be trusted by those clients. This is especially the case when such a WSC is itself a WSP that needs to obtain consent or permissions. There is no general possibility for an IS to proof on-line that it did indeed obtain the response from the Principal. The IS can and should of course authenticate the Principal, and could then save the proof of authentication, such as an assertion. There is little point in forwarding such assertion to the WSC as proof, as an ID-FF authentication assertion will contain the `NameIdentifier` of the Principal as known to the IS, not to the WSC. An IS that is closely associated with an IdP, i.e. has the same providerID as that IdP, could actually issue an assertion that states that the Principal as known to the WSC was present. Such statements could be added as SOAP header to the InteractionResponse message (see ID-WSF Security Profiles.

It is not sufficient to know that a Principal was present at the IS. There is still the possibility that a rogue IS created or changed the Principals answers in the `<InteractionResponse>`. The Interaction Service client can verify the integrity of the response if the answered `Inquiry` is signed with a key that is: either shared between the Principal and the WSC, or is the private key of the Principal and the WSC knows that the associated public key is bound to the Principal. To this end the WSC can include such public asymmetric key in the `<InteractionRequest>`. Naturally the WSC should have consent from the Principal to share that key with the IS. Use of a private key is preferred for a more provable audit trail of the Principals answers to the inquiry.

For the Redirect Profile the previous considerations do not apply, as parties that need to interact with a resource owner do so themselves. Here it is again important that the WSP authenticates the Principal. Although the information flow in the redirects does not contain very valuable information it is still recommended to use secure connections so that intruders cannot steal a session and hence for example reissue a request. This risk is reduced if WSPs require that all ID-WSF requests are signed and/or authenticate WSCs. Also all participants should protect themselves against replay by checking for recently used messageIDs, etc.

The Principal has a risk that an IS, or for that matter any WSP, may misrepresent him. IS providers should make efforts to induce trust in the Principal, for example by offering transaction logs, deploying sufficiently strong authentication methods, etc.

Bibliography

Normative

[ref_HTTP] "HTTP1.1 spec," RFC2616.

[ref_SOAP] "SOAP 1.1 specification,"

[ref_ISFMessages] "ID-WSF SOAP Binding,"

[ref_ISFSecurityProfs] "ID-WSF Security Profiles,"

[ref_Disco] "ISF Discovery Service,"

[ref_RFC2119] "RFC2119,"

[ref_RFC3066] "Tags for the Identification of Languages," RFC3066.

[ref_WML] "Wireless Application Protocol, Wireless Markup Language Specification, Version 1.3,"

Informative

[ref_PAOS] "Reversed HTTP Binding For SOAP,"

[ref_IFF_ProtSchema] "ID-FF Protocols and Schemas 1.1,"

[ref_IFF_BindProf] "IS-FF Bindings and Profiles 1.2,"

A. Appendix A: XSD

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="urn:liberty:is:1.0"
   xmlns="urn:liberty:is:1.0"
   xmlns:is="urn:liberty:is:1.0"
   xmlns:dsc="urn:liberty:wsf:disco:1.0"
   xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
   xmlns:ds="http://www.w3.org/2000/09/xmldsig#"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
   elementFormDefault="qualified" attributeFormDefault="unqualified"
   version="1.0-03">
   <xs:annotation>
      <xs:documentation>Copyright 2003 Liberty Alliance Project</xs:documentation>
   </xs:annotation>
   <xs:include schemaLocation="lib-arch-iwsf-utility.xsd"/>
   <xs:import namespace="http://schemas.xmlsoap.org/soap/envelope/"
 schemaLocation="http://schemas.xmlsoap.org/soap/envelope/"/>
   <xs:import namespace="urn:liberty:wsf:disco:1.0"
 schemaLocation="lib-arch-disco-svc.xsd"/>
   <xs:import namespace="http://www.w3.org/2000/09/xmldsig#"
 schemaLocation="http://www.w3.org/TR/xmldsig-core/xmldsig-core-schema.xsd"/>
   <xs:element name="UserInteraction" type="is:UserInteractionHeaderType"/>
   <xs:complexType name="UserInteractionHeaderType">
      <xs:sequence>
         <xs:element name="InteractionService" type="dsc:ServiceInstanceType" minOccurs="0"/>
      </xs:sequence>
      <xs:attribute name="interact" type="xs:QName" use="optional" default="is:InteractIfNeeded"/>
      <xs:attribute name="language" type="xs:NMTOKENS" use="optional"/>
```

```
      <xs:attribute name="redirect" type="xs:boolean" use="optional" default="0"/>
      <xs:attribute name="maxInteractTime" type="xs:integer" use="optional"/>
      <xs:attribute ref="soap:actor" use="optional"/>
      <xs:attribute ref="soap:mustUnderstand" use="optional"/>
   </xs:complexType>
   <xs:element name="RedirectRequest" type="is:RedirectRequestType"/>
   <xs:complexType name="RedirectRequestType">
      <xs:attribute name="redirectURL" type="xs:anyURI" use="required"/>
   </xs:complexType>
   <xs:element name="Resource" type="xs:anyURI"/>
   <xs:element name="InteractionRequest" type="is:InteractionRequestType"/>
   <xs:complexType name="InteractionRequestType">
      <xs:sequence>
         <xs:element ref="Resource"/>
         <xs:element ref="is:Inquiry" maxOccurs="unbounded"/>
         <xs:element ref="ds:KeyInfo" minOccurs="0"/>
      </xs:sequence>
      <xs:attribute name="maxInteractTime" type="xs:integer" use="optional"/>
      <xs:attribute name="signed" type="xs:token" use="optional"/>
   </xs:complexType>
   <xs:element name="Inquiry" type="is:InquiryType"/>
   <xs:complexType name="InquiryType">
      <xs:choice>
         <xs:element ref="is:Help" minOccurs="0"/>
         <xs:element ref="is:Select" minOccurs="0" maxOccurs="unbounded"/>
         <xs:element name="Confirm" type="is:InquiryElementType" minOccurs="0" maxOccurs="unbounded"/>
         <xs:element ref="is:Text" minOccurs="0" maxOccurs="unbounded"/>
      </xs:choice>
      <xs:attribute name="id" type="xs:ID" use="optional"/>
      <xs:attribute name="title" type="xs:string" use="optional"/>
   </xs:complexType>
   <xs:element name="Help" type="is:HelpType"/>
   <xs:complexType name="HelpType">
      <xs:attribute name="label" type="xs:string" use="optional"/>
      <xs:attribute name="link" type="xs:anyURI" use="optional"/>
      <xs:attribute name="moreLink" type="xs:anyURI" use="optional"/>
   </xs:complexType>
   <xs:element name="Hint" type="xs:string"/>
   <xs:element name="Select" type="is:SelectType"/>
   <xs:complexType name="SelectType">
      <xs:complexContent>
         <xs:extension base="is:InquiryElementType">
            <xs:sequence>
               <xs:element name="Item" minOccurs="2" maxOccurs="unbounded">
                  <xs:complexType>
                     <xs:sequence>
                        <xs:element ref="is:Hint" minOccurs="0"/>
                     </xs:sequence>
                     <xs:attribute name="label" type="xs:string" use="optional"/>
                     <xs:attribute name="value" type="xs:NMTOKEN" use="required"/>
                  </xs:complexType>
               </xs:element>
            </xs:sequence>
            <xs:attribute name="multiple" type="xs:boolean" use="optional" default="false"/>
         </xs:extension>
      </xs:complexContent>
   </xs:complexType>
   <xs:element name="Text" type="is:TextType"/>
   <xs:complexType name="TextType">
      <xs:complexContent>
         <xs:extension base="is:InquiryElementType">
            <xs:attribute name="minChars" type="xs:integer" use="optional"/>
            <xs:attribute name="maxChars" type="xs:integer" use="optional"/>
            <xs:attribute name="format" type="xs:string" use="optional"/>
         </xs:extension>
      </xs:complexContent>
   </xs:complexType>
   <xs:complexType name="InquiryElementType" abstract="true">
      <xs:sequence>
         <xs:element ref="is:Help" minOccurs="0"/>
         <xs:element ref="is:Hint" minOccurs="0"/>
         <xs:element name="Label" type="xs:normalizedString" minOccurs="0"/>
         <xs:element name="Value" type="xs:normalizedString" minOccurs="0"/>
      </xs:sequence>
      <xs:attribute name="name" type="xs:ID" use="required"/>
   </xs:complexType>
   <xs:element name="InteractionResponse" type="is:InteractionResponseType"/>
```

```
   <xs:complexType name="InteractionResponseType">
      <xs:sequence>
         <xs:element ref="Status" />
         <xs:choice>
            <xs:element name="InteractionStatement" type="is:InteractionStatementType" minOccurs="0"/>
            <xs:element name="Parameter" type="is:ParameterType" minOccurs="0" maxOccurs="unbounded"/>
         </xs:choice>
      </xs:sequence>
   </xs:complexType>
   <xs:complexType name="InteractionStatementType">
      <xs:sequence>
         <xs:element ref="is:Inquiry"/>
         <xs:element ref="ds:Signature"/>
      </xs:sequence>
   </xs:complexType>
   <xs:complexType name="ParameterType">
      <xs:attribute name="name" type="xs:ID" use="required"/>
      <xs:attribute name="value" type="xs:string" use="required"/>
   </xs:complexType>
</xs:schema>
```

B. Appendix B: WSDL

```
<wsdl:definitions
   xmlns:typens="urn:liberty:isf:1.0:wsdl"
   xmlns:xsd="http://www.w3.org/2001/XMLSchema"
   xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
   xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
   xmlns="http://schemas.xmlsoap.org/wsdl/"
   targetNamespace="urn:liberty:isf:1.0:wsdl" name="ISF">
   <wsdl:types>
      <import namespace="urn:liberty:is:1.0" location="id-wsf-is.xsd"/>
   </wsdl:types>
   <message name="InteractionRequest">
      <part name="body" type="is:InteractionRequest"/>
   </message>
   <message name="InteractionResponse">
      <part name="body" type="is:InteractionResponse"/>
   </message>
   <portType name="ISPort">
      <operation name="ISInteraction">
         <input message="typens:InteractionRequest"/>
         <output message="typens:InteractionResponse"/>
      </operation>
   </portType>
   <binding name="ISBinding" type="typens:ISPort">
      <soap:binding style="document" transport="http://schemas.xmlsoap.org/soap/http"/>
      <operation name="Interaction">
         <soap:operation soapAction="urn:liberty:is:1.0"/>
         <input>
            <soap:body use="literal"/>
         </input>
         <output>
            <soap:body use="literal"/>
         </output>
      </operation>
   </binding>
   <service name="InteractionService">
      <port name="ISPort" binding="typens:ISBinding">
         <soap:address location="http://example.com/id-wsf/is"/>
      </port>
   </service>
   <!- Types for messages ->
   <!- Messages for core identity services ->
   <!- Ports for core identity services ->
   <!- Binding for discovery service ->
   <!- Endpoint for core identity services ->
</wsdl:definitions>
```

C. Appendix C: Example XSL stylesheet for HTML forms (non-normative)

```
<?xml version="1.0" encoding="UTF-8"?>
<!- This stylesheet converts an is:Inquiry into an HTML form.
     TODO: write the actual stylesheet content ->
<xsl:stylesheet version="1.0"
   xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
   xmlns:fo="http://www.w3.org/1999/XSL/Format">
</xsl:stylesheet>
```

D. Appendix D: Example XSL stylesheet for WML forms (non-normative)

```
<?xml version="1.0" encoding="UTF-8"?>
<!- This stylesheet converts an is:Inquiry into a WML deck.
     TODO: write the actual stylesheet content ->
<xsl:stylesheet version="1.0"
   xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
   xmlns:fo="http://www.w3.org/1999/XSL/Format">
</xsl:stylesheet>
```