



Food and Agriculture
Organization of the
United Nations



The International Treaty
ON PLANT GENETIC RESOURCES
FOR FOOD AND AGRICULTURE

XML integration protocol of the Global Information System

History of changes

This document is available at

<http://www.fao.org/plant-treaty/areas-of-work/global-information-system/techdoc/en/>

Please refer to the above URL for later versions of this document.

Version	Date	Description
3.5	09/02/2018	Clarified description of <historical>. Added endpoint addtargets to add new targets to existing DOIs. Clarified that Easy-SMTA PIDs should always be provided when available, even if the WIEWS code is already provided. Modified behavior of update regarding targets. If no target is specified in the update message, targets and associated keyword codes are left unchanged. Harmonized with version 2.1 of document “Data required for the assignation of Digital Object Identifiers in the Global Information System”
3.4	21/07/2017	Modified element <exist> into <historical>
3.3	20/07/2017	Updated to new version of descriptors. Species (specific epithet) is now a mandatory descriptor but, if not provided, sp. is assumed. Physical existence of the material is no longer assumed. The new element <exist> is introduced with values y or n. If empty or not present, y is assumed. New target keyword list
3.2	16/07/2017	Restructured registration and update XML to support XSD validation.
3.1	12/07/2017	Removed identifier type GenesysID and fixed case in registration example. Improved explanation of <error> element.
3.0	25/06/2017	Added transfer transaction
2.0	17/05/2017	Added update transaction
1.2	19/04/2017	Added HTTP response code 503 due to maintenance.
1.1	11/04/2017	Better described the format of error messages that may be returned before the XML is parsed. Added <genus> to the HTTPS reply to address those cases in which <sampleid> alone would not be sufficient to uniquely identify the record to update.
1.0	29/03/2017	Removed geographic coordinates from holding location. Updated link to Descriptors document
0.16	28/03/2017	Changed document name to “XML integration protocol”. Changed test URL
0.15	22/03/2017	Corrected element <progdoi> to have one or more children <doi>
0.14	21/02/2017	Removed <historical> element because registration assumes that the material is available
0.13	06/02/2017	Changed format of DMS coordinates to ddDmmMssSX
0.12	02/02/2017	Updated to match v2 of the descriptors
0.11	31/01/2017	Corrected code for “Other” in Table 4 “biostatus” to make it directly compatible with MCPD
0.10	02/12/2016	Clarified that address is optional in actor and location elements. Added historical and user-defined country codes. Added minimal example
0.9	14/11/2016	idType codes are now all lowercase
0.8	03/11/2016	Described the registration process in natural language
0.7	02/11/2016	Clarified that each XML registration request must contain a single <register> element with a single PGRFA inside
0.6	01/11/2016	Added PURL to idType and pictures to target keywords
0.5	25/10/2016	Added missing table on bioStatus codes. Corrected idType codes. Added new target keywords
0.4	24/10/2016	Removed language code from crop name element

0.3	14/09/2016	Separate species, species authority, subtaxa and subtaxon authority for better MCPD and DarwinCore compatibility
0.2	02/05/2016	Added possibility of providing an existing DOI for the material being registered
0.1	30/03/2016	Initial draft

Introduction

This document describes the XML document to be used to register Plant Genetic Resources for Food and Agriculture (PGRFA) to the Global Information System (GLIS) of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Upon successful registration, GLIS will return the Digital Object Identifier (DOI) associated with PGRFA.

GLIS also allow for the update of descriptors associated to a PGRFA already registered as well as for the transfer of PGRFA from Provider to Recipient.

For confidentiality, all transactions are performed using HTTPS, the secure version of the HTTP protocol. To establish a secure HTTP connection, the external system must send the request to the following URL (port 443):

<https://glistest.planttreaty.org/glis/xml/manager>

and properly handle the HTTPS handshake. It is recommended to check the documentation corresponding to the development language used on the external system's side.

The above URL is the unique entry point for all the transactions described in this document: registration, update and transfer.

For compatibility with non-ASCII characters, the UTF-8 character set is required to be specified in the encoding attribute of the XML object.

Please note that the above URL is for testing only. The credentials to be provided in the HTTPS request must be requested to the ITPGRFA Secretariat through an email to PGRFA-Treaty@fao.org. The URL of the production server's unique entry point as well as the final access credentials will be provided once the tests are successfully completed.

For additional details on the meaning of each element please refer to the latest version of document "Data required for the assignation of Digital Object Identifiers in the Global Information System" available at

<http://www.fao.org/plant-treaty/areas-of-work/global-information-system/descriptors/en/>

Albeit only a handful of descriptors are mandatory for registration, it is strongly recommended to provide as much information as possible to allow GLIS to offer more powerful services to its users.

The registration process can be described in natural language as follows:

```

Query your database to find all records that need to be registered
For each of the records found above repeat {
  Compile the XML registration document as described below
  Encapsulate the XML registration document into a HTTPS POST request
  Send the HTTPS POST request to the GLIS URL
  Examine the XML response message received by GLIS
  If the response contains an <error> element {
    Log the XML response somewhere for further inspection
  } else {
    update local database using something like:
    UPDATE {yourTable}
      SET doi = {<doi> element of the response}
      WHERE {your sampleid column} = {<sampleid> element of the response};
  }
}

```

In some institutions, sampleid alone is not unique because numbering is done separately for different collections. To deal with these cases, GLIS returns the genus of the PGRFA if provided in the registration request. Therefore, the UPDATE SQL statement above would be

```

UPDATE {yourTable}
  SET doi = {<doi> element of the response}
  WHERE
    {your sampleid column} = {<sampleid> element of the response}
    AND
    {your genus column} = {<genus> element of the response};

```

Some requests may fail for a variety of reasons (see “Error conditions” below). You should inspect the errors logged, adopt the necessary correcting measures and submit the failed requests again. GLIS provides error messages that are usually self-explanatory. In case of need, please do not hesitate to contact us for assistance.

The update transaction works in a very similar fashion to the registration transaction.

HTTPS request

The external system must send requests to GLIS using an HTTPS POST request with the XML document described below as request body. The XML document is not compressed.

As per XML standard, newlines can be inserted into the element value either through the `` escape sequence or explicitly. For instance, the following two elements are equivalent:

```
<xxx>This is the first line&#xD;This is the second line</xxx>
```

```
<xxx>This is the first line  
This is the second line</xxx>
```

System unavailability

GLIS may be unavailable due to scheduled maintenance activities. In this case, sending a request will result in a HTTP response code 503: `Service Unavailable` and there will be no response body. It is therefore necessary to check the HTTP code of the response before attempting to process the response.

Error conditions

Upon receiving the HTTPS request, GLIS performs some preliminary checks that may result in an error response with the following structure:

```
<?xml version="1.0" encoding="UTF-8"?>  
<response>  
  <error>[message]</error>  
</response>
```

where [message] can be one of the following:

Access denied

The username and or password specified in the XML document are not valid. Contact the GLIS System Administrator at PGRFA-Treaty@fao.org to obtain valid access credentials. Please note that username and password to be used in the XML document are not the same used to login to GLIS as user.

Request sent over HTTP instead of HTTPS

For security reasons, GLIS requires HTTPS. Please adjust your sending application to use HTTPS.

XML parsing errors

Additionally, when the XML document is parsed by GLIS, some errors may be found as detailed in the error message. Please note that any error listed here refers to the XML syntax and not to the content of the XML document, which will be analyzed next.

If none of the above error conditions occurs, GLIS validates the XML object included in the HTTPS POST and responds with a XML object depending on the success or failure and the type of the transaction as described in the corresponding chapter.

PGRFA registration

The purpose of this transaction is to obtain a DOI associated to the PGRFA by providing a set of descriptors in the registration request. However, if a DOI obtained through a service other than GLIS is

already associated to the PGRFA, it must be provided in the request so that GLIS will not assign a new DOI but adopt the one provided.

The purpose of the registration is to provide metadata to be associated to the DOI. Providing as much information as possible is recommended because it will facilitate users when they resolve DOIs in GLIS or discover PGRFA using the metadata provided.

Request

The general structure of the XML registration request is as follows:

```
<?xml version="1.0" encoding="utf-8"?>
<register>
  <mandatory elements>
  <highly recommended elements>
  <context elements>
</register>
```

There is only one <register> element referring to a single PGRFA. It contains mandatory elements and may contain optional and context elements. Context elements are in turn grouped into elements (<acquisition>, <collection> and <breeding>); one or more elements can be specified depending on the information being provided.

Minimal example

The following is a minimal example with just mandatory and some highly recommended elements.

```
<?xml version="1.0" encoding="UTF-8" ?>
<register username="cgn" password="Passw0rd">
  <sampleid>CGN00001</sampleid>
  <genus>Hordeum</genus>
  <species>vulgare</species>
  <cropnames>
    <name>Barley</name>
  </cropnames>
  <spauth>L.</spauth>
  <subtaxa>subsp. vulgare</subtaxa>
  <stauth>L.</stauth>
  <method>acqu</method>
  <biostatus>300</biostatus>
  <mlsstatus>1</mlsstatus>
  <date>1986-05-12</date>
  <location>
    <wiews>NLD037</wiews>
  </location>
  <targets>
    <target>
      <value>http://www.nordgen.org/sgsv/index.php?unit_id=239741</value>
      <kws>
        <kw>5</kw>
      </kws>
    </target>
  </targets>
  <names>
    <name>Maartsche Gerst</name>
  </names>
  <ids>
    <id type="sgsvid">239741</id>
    <id type="genesysuuid">urn:uuid:89e8a52d-5b79-4510-b209-af0f48254cea</id>
  </ids>
  <acquisition>
    <provider>
      <wiews>NLD078</wiews>
```

```

    </provider>
    <sampleid>GZ A1</sampleid>
    <provenance>NLD</provenance>
  </acquisition>
</register>

```

Actor or location element

In a few cases, a block of elements is used to identify an actor or the location where the PGRFA is conserved. Actors are:

- provider of the PGRFA
- collector(s)
- breeder(s)

In all these cases, the composition of the elements block is the same:

```

<wiews>[wiews]</wiews>
<pid>[pid]</pid>
<name>[name]</name>
<address>[address]</address>
<country>[country]</country>

```

Where:

[wiews] is the FAO WIEWS Institute code (<http://www.fao.org/wiews>)
 [pid] is the Permanent Identifier assigned by Easy-SMTA (<https://mls.planttreaty.org>)
 [name] is the name of the individual or organization
 [address] is the address of the individual or organization
 [country] is the ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) with the extensions listed in Table 7

One between <wiews> and <pid> is enough to fully identify the location or actor. If available, they should be used so that GLIS can fetch the information from WIEWS or Easy-SMTA as appropriate. However, when neither the WIEWS institute code nor the Easy-SMTA PID is available, the other three elements should be indicated. For instance, in the case of <breeder>, the following alternatives are equivalent:

WIEWS Institute code	Easy-SMTA PID	Neither of the two
<pre> <breeder> <wiews>PHL001</wiews> </breeder> </pre>	<pre> <breeder> <pid>00AB40</pid> </breeder> </pre>	<pre> <breeder> <name>IRRI</name> <address>Los Baños, Laguna</address> <country>PHL</country> </breeder> </pre>

If more than one among <wiews>, <pid> and the explicit elements (<name>, <address> and <country>) are present, the order of precedence is <wiews> => <pid> => explicit elements. If explicit elements are used, at least name and country must be present, address is optional.

Please note that it is recommended to provide the Easy-SMTA PID even if the FAO WIEWS code is already specified.

XML request object

The body of the HTTPS POST registration request is as follows. Elements marked with * can be repeated multiple times. Some elements can be specified instead of others. See the element description for mandatory requirements and other details. The order of the elements within their parent element is irrelevant. Optional elements may be indicated as empty (e.g. <element/> or <element></element>) or omitted altogether.

```

<?xml version="1.0" encoding="UTF-8" ?>
<register username="[username]" password="[password]">
  <location> <!-- Location element -->
    <wiews>[lwiews]</wiews>
    <pid>[lpid]</pid>
    <name>[lname]</name>
    <address>[laddress]</address>
  </location>
</register>

```

```

    <country>[ lcountry ]</country>
</location>
<sampledoi>[sampledoi]</sampledoi>
<sampleid>[ sampleid ]</sampleid>
<date>[ date ]</date>
<method>[ method ]</method>
<genus>[ genus ]</genus>
<cropnames>
    <name>[ cropname ]</name>*
</cropnames>

<targets>
    <target>*
        <value>[ tvalue ]</value>
        <kws>
            <kw>[ tkw ]</kw>*
        </kws>
    </target>
</targets>
<progdoi>
    <doi>[ progdoi ]</doi>*
</progdoi>
<biostatus>[ biostatus ]</biostatus>
<species>[ species ]</species>
<spauth>[ spauth ]</spauth>
<subtaxa>[ subtaxa ]</subtaxa>
<stauth>[ stauth ]</stauth>
<names>
    <name>[ nvalue ]</name>*
</names>
<ids>
    <id type="[ itype ]">[ ivalue ]</id>*
</ids>
<mlsstatus>[ mlsstatus ]</mlsstatus>
<historical>[ hist ]</historical>

<acquisition>
    <provider>      <!-- Actor element -->
        <wiews>[ pwiews ]</wiews>
        <pid>[ ppid ]</pid>
        <name>[ pname ]</name>
        <address>[ paddress ]</address>
        <country>[ pcountry ]</country>
    </provider>
    <sampleid>[ psampleid ]</sampleid>
    <provenance>[ provenance ]</provenance>
</acquisition>

<collection>
    <collectors>
        <collector>*      <!-- Actor element -->
            <wiews>[ cwiews ]</wiews>
            <pid>[ cpid ]</pid>
            <name>[ cname ]</name>
            <address>[ caddress ]</address>
            <country>[ ccountry ]</country>
        </collector>
    </collectors>
    <sampleid>[ csampleid ]</sampleid>
    <missid>[ missid ]</missid>
    <site>[ site ]</site>
    <lat>[ clat ]</lat>
    <lon>[ clon ]</lon>
    <uncert>[ uncert ]</uncert>
    <datum>[ datum ]</datum>
    <georef>[ georef ]</georef>
    <elevation>[ elevation ]</elevation>
    <date>[ cdate ]</date>
    <source>[ source ]</source>
</collection>

<breeding>
    <breeders>

```

```

    <breeder>* <!-- Actor element -->
      <wiews>[wiews]</wiews>
      <pid>[pid]</pid>
      <name>[name]</name>
      <address>[address]</address>
      <country>[country]</country>
    </breeder>
  </breeders>
  <ancestry>[ancestry]</ancestry>
</breeding>
</register>

```

where (unless otherwise specified, elements are optional, the DID column refers to the descriptor ID in the document "Data required for the assignation of Digital Object Identifiers in the Global Information System" mentioned above:

Field	DID	Type	Max length or format	Description
[username]	N/A	String	128	Username assigned by the GLIS System Administrator to the requesting system. Mandatory.
[password]	N/A	String	128	Password assigned by the GLIS System Administrator to the requesting system. Mandatory.
[lwiews]	M01	String	16	FAO WIEWS Institute code of the organization where the PGRFA is conserved. See "Actor or location element" for details.
[lpid]	M01	String	16	Easy-SMTA PID of the organization, legal entity or individual conserving the PGRFA. See "Actor or location element" for details.
[lname]	M01	String	128	Surname and name of individuals or organization name of the organization or legal entity conserving the PGRFA. See "Actor or location element" for details.
[laddress]	M01	String	128	Address of the organization, legal entity or individual conserving the PGRFA. See "Actor or location element" for details.
[lcountry]	M01	String	3	ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the organization, legal entity or individual conserving the PGRFA. See "Actor or location element" and Table 7 for details.
[sampledoi]	N/A	String	128	A Digital Object Identifier (DOI) obtained from a service other than GLIS and that is already assigned to the PGRFA.
[sampleid]	M02	String	128	A string that <i>uniquely</i> identifies the PGRFA that is being registered in holder's collection. This value will be returned by GLIS in the response message and is assumed to be used to associate the DOI to the corresponding material in the local database. You must provide <sampleid> even if <sampledoi> is provided. In case you use the DOI as unique identifier in your local database, you can repeat it in <sampleid>. Mandatory. Please read more details in the "HTTPS reply" chapter.
[date]	M03	Date	YYYY-MM-DD	Date in which PGRFA became part of the collection. Date fragments (YYYY-MM and YYYY) are also accepted.
[method]	M04	String	4	Method through which the PGRFA has been obtained. Mandatory. See Table 1 for the codes accepted by this element.
[genus]	M05	String	64	The taxon of the genus for the PGRFA. At least one between <genus> and <cropname> must be provided.
[species]	M05	String	128	Specific epithet of the PGRFA scientific name. If not provided, sp. is assumed
[cropname]	M05	String	128	Common name of the PGRFA or crop name. At least one between <genus> and <cropname> must be provided. Multiple <name> elements are allowed.
[tvalue]	R01	String	256	URL of the target page where additional information on the PGRFA can be found. The URL must be URL-encoded. Any number of <target> elements can be provided.
[tkw]	R01	String	16	Code of the keyword indicating the type of information that will be found at the given target URL. See Table 2 below.
[progdoi]	R02	String	GLIS DOI	DOI of the PGRFA(s) from which the current PGRFA was derived. The DOI must be registered in GLIS. Please note that the number

				of allowed DOIs depends on the method as follows: Acquisition: 1 DOI In-house copy: 1 DOI In-house variant: 1 DOI Novel distinct PGRFA: 1 or more DOIs Observation - Natural: 0 DOI Observation – Inherited: 0 DOI
[biostatus]	R03	String	3	Biological status of the PGRFA. See Table 3 below.
[spauth]	R04	String	64	Authority for the specific epithet
[subtaxa]	R04	String	128	Any additional infra-specific taxon such as subspecies, variety, form, Group and so on
[stauth]	R04	String	64	Authority for the subtaxon at the most detailed level provided
[nvalue]	R05	String	128	Other name or designations of the PGRFA. Any number of <name> elements can be provided.
[itype]	R06	String	16	Code of the identifier type. The attribute is mandatory. See Table 4 below.
[ivalue]	R06	String	128	Other identifier of the type indicated by the attribute type assigned to the PGRFA
[mlsstatus]	R07	String	2	Code that identifies the status of the PGRFA with regard to the MLS. See Table 5 below.
[hist]	R08	String	1	Indicates whether the PGRFA no longer exists. Allowed value is y/n with y=material is no longer available and n=material available
[pwiews]	A01	String	16	FAO WIEWS code of the organization providing the PGRFA. See "Actor element" for details.
[ppid]	A01	String	16	Easy-SMTA PID of the organization, legal entity or individual providing the PGRFA. See "Actor element" for details.
[pname]	A01	String	128	Surname and name for individuals or organization or legal entity name of the provider. See "Actor element" for details.
[paddress]	A01	String	128	Address of the organization, legal entity or individual providing the PGRFA. multiple lines are accepted. See "Actor element" for details.
[pcountry]	A01	String	3	ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the organization, legal entity or individual providing the PGRFA. See "Actor element" and Table 7 for details.
[psampleid]	A02	String	128	Unique identifier for the PGRFA in the provider's management.
[provenance]	A03	String	3	ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the country in which the PGRFA material was either collected or bred or selected, or the first country in the known history of the PGRFA. See Table 7 for details
[cwiews]	A04	String	16	FAO WIEWS code of the organization collecting the PGRFA. See "Actor element" for details. Any number of <collector> can be provided.
[cpid]	A04	String	16	Easy-SMTA PID of the organization, legal entity or individual collecting the PGRFA. See "Actor element" for details.
[cname]	A04	String	128	Surname and name for individuals or organization or legal entity name of the collector. See "Actor element" and Table 7 for details.
[caddress]	A04	String	128	Address of the organization, legal entity or individual collecting the PGRFA. Multiple lines are accepted. See "Actor element" and Table 7 for details.
[ccountry]	A04	String	3	ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the country of the organization, legal entity or individual collecting the PGRFA. See "Actor element" and Table 7 for details.
[csampleid]	A05	String	128	Identifier assigned by the collector(s) to the PGRFA collected.
[missid]	A06	String	128	Identifier of the collecting mission
[site]	A07	String	128	Description of the location where the PGRFA was collected

[clat]	A08	String	10	Latitude where the PGRFA was collected in either dd°mm'ss"X (where X is N or S) format or ddd.xxxxx (up to 5 decimals, preceded by minus sign for S) format. No spaces are allowed.
[clon]	A09	String	10	Longitude where the PGRFA was collected in either dd°mm'ss"X (where X is E or W) format or ddd.xxxxx (up to 5 decimals, preceded by minus sign for W) format. No spaces are allowed.
[uncert]	A10	String	16	Uncertainty of lat/lon coordinates
[datum]	A11	String	16	Geodetic <i>datum</i> of the lat/lon coordinates
[georef]	A12	String	16	Georeferencing method
[elevation]	A13	Integer	16	Elevation of collecting site in metres above sea level
[cdate]	A14	Date	YYYY-MM-DD	Date on which the PGRFA was collected. Date fragments (YYYY-MM and YYYY) are also accepted.
[source]	A15	String	2	Code of the nature of the location where the PGRFA was collected. See Table 6 below.
[bwiews]	A16	String	16	FAO WIEWS code of the breeding organization. See "Actor element" for details. Any number of <breeder> can be provided.
[bpid]	A16	String	16	Easy-SMTA PID of the breeding organization, legal entity or individual. See "Actor element" for details.
[bname]	A16	String	128	Surname and name for individuals or organization name of the breeder. See "Actor element" for details.
[baddress]	A16	String	128	Address of the breeding organization, legal entity or individual . Multiple lines are accepted. See "Actor element" for details.
[bcountry]	A16	String	3	ISO-3166 alpha-3 country code (https://en.wikipedia.org/wiki/ISO_3166-1_alpha-3) of the breeding organization, legal entity or individual. See "Actor element" and Table 7 for details.
[ancestry]	A17	String	65.536	Pedigree or other description of the ancestry of the PGRFA and how it was bred.

Response

If the request passes the preliminary checks, GLIS validates the XML object included in the HTTPS POST and responds with a XML object as follows:

```
<?xml version="1.0" encoding="utf-8"?>
<response>
  <sampleid>[sampleID]</sampleid>
  <genus>[genus]</genus>
  <doi>[DOI]</doi>
  <error>[message]</error>
</response>
```

where:

[sampleid] is the local sample identifier sent in the request
[genus] is the genus of the PGRFA
[DOI] is the DOI associated with the PGRFA upon registration
[message] is the error message generated during the validation of the registration request

The <error> element is present if any problem is found with the registration request and <doi> is not present as the registration has failed. Error messages are usually self-explanatory.

Please note that if the registration message includes an already existing DOI for the PGRFA in element <samplDOI>, it will be returned in <doi>. Also, the <genus> element will be present if it was provided in the registration request.

In some institutions local identifiers are assigned separately for each collection. This means that the local identifier, indicated in <sampleid>, alone would not be sufficient to uniquely identify the record to which the newly minted DOI should be associated. In those cases, the pair (genus, sampleid) is unique and this is why the genus is returned in the reply if it was provided in the registration request.

PGRFA update

Updating the descriptors associated with an already registered PGRFA is done using a message similar to the registration one described above. The idea would be that the query and the preparation of the XML message to be sent to GLIS would be quite the same for registrations and updates.

The only differences are:

- the XML root is named <update> instead of <register>
- the <samplDOI> element is mandatory and must contain the DOI of the PGRFA whose descriptors are being updated. Such DOI must have been previously registered in GLIS
- if the <targets> element is missing or empty, targets and associated keyword codes are left unchanged

All other rules and remarks provided on the registration chapter above apply. Using the update request, it is possible to modify any descriptor associated with the material, including targets. Relationships can be edited as appropriate but only limited to those in which the PGRFA is subject of the relationship (i.e. the ancestry or those that were submitted during registration of the same PGRFA). It is not possible to modify relationships to this PGRFA that were established when other PGRFA were registered (i.e. the progeny).

The provided XML document is validated through the same procedure used for the registration request; error messages and the success response are exactly the same.

PGRFA transfer

When PGRFA is transferred from a Provider to a Recipient, the accurate and timely communication of descriptors associated with the PGRFA is important. Additionally, the transfer establishes a relationship among the PGRFA once incorporated in the Recipient's collection and the original material in the Provider's collection. Such relationship will allow the Recipient to access all information associated to the parent material and the Provider to access information produced by the Recipient and those who may have received the Recipient's material in subsequent transfers.

The transfer is implemented by a set of three transactions:

- 1) *Transfer request* sent by the Provider to GLIS that will route it to the Recipient. The request is sent to GLIS and not directly to the Recipient because GLIS maintains a central registry of URLs of Recipient systems which is much easier to keep up to date. Also, Recipient systems can restrict access to GLIS only with benefits for security. Finally, GLIS performs validation checks on the request so that errors can be identified right away.
- 2) *Recipient harvesting information about the material* from GLIS. The Recipient system queries GLIS for details about each PGRFA listed in the transfer request ensuring that descriptors are transferred accurately and quickly.
- 3) *Recipient registering received material* to obtain new DOIs. When the received material is incorporated in the Recipient's collection, it is registered in GLIS using the registration transaction described above. To establish the relationship with the parent material, it is critical that element <progDOI> is populated with the Provider's DOI of the PGRFA taken from the registration request. This final step is optional but it is strongly recommended to allow GLIS provide its value-added services and allow access to information associated to the PGRFA produced both upstream and downstream.

To simplify processing, Provider and Recipient are specified through the Easy-SMTA user Permanent Identifier (PID). This means that, for the transaction to work, both parties must register on Easy-SMTA (<https://mls.planttreaty.org>) and obtain the PID. Registration is free of charge and immediate and must be done only once as the PID can be used for any number of transactions and is also used to report transfers implemented through the Standard Material Transfer Agreement (SMTA, <http://www.fao.org/plant-treaty/areas-of-work/the-multilateral-system/the-smta>) in the framework of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, <http://www.fao.org/plant-treaty>).

Transfer request

The transfer request is sent by the Provider's system to GLIS. The timing of the request depends on the terms of the transfer agreed by Provider and Recipient. As a rule of thumb, the request should be sent when the material is shipped.

The request is considered successful if it passes the validation performed by GLIS and is sent to the Recipient's system. If the forwarding of the request to the Recipient system fails, it is responsibility of the Provider's system to retry the request after some delay.

The structure of the XML object to be put in the body of the HTTPS message is as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
<transfer username="[username]" password="[password]">
  <providerpid>[provPID]</providerpid>
  <recipientpid>[recPID]</recipientpid>
  <symbol>[symbol]</symbol>
  <type>[type]</type>
  <materials>
    <doi>[doi]</doi>
    ...
  </materials>
</transfer>
```

There is only one <transfer> element referring to a single transfer. Use one <doi> element for each material being transferred in the same shipment. If multiple samples of the same material are shipped, use only one <doi> element. All elements are mandatory and their contents are:

Field	Type	Max length or format	Description
[username]	String	128	Username assigned by the GLIS System Administrator to the requesting system
[password]	String	128	Password assigned by the GLIS System Administrator to the requesting system
[provPID]	String	16	Easy-SMTA PID of the Provider
[recPID]	String	16	Easy-SMTA PID of the Recipient
[symbol]	String	128	Transfer identifier, for example the code or number assigned to the contract regulating the transfer. For SMTAs, use the symbol identifying the SMTA
[type]	String	4	Type of transfer. Allowed values: SMTA or MTA
[doi]	String	128	DOI of the material. Must be registered in GLIS.

Response

If the transfer request passes the preliminary checks, GLIS validates the XML object included in the HTTPS POST and responds with a XML object as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
<response>
  <providerpid>[provPID]</providerpid>
  <recipientpid>[recPID]</recipientpid>
  <symbol>[symbol]</symbol>
  <type>[type]</type>
  <result>[res]</result>
  <error>[message]</error>
  ...
</response>
```

where:

[provPID] is the Provider's PID from the request
 [recPID] is the Recipient's PID from the request
 [symbol] is the transfer identifier from the request
 [type] is the transfer type from the request
 [res] is OK if the request was successful or KO otherwise
 [message] the error message(s) generated during the validation of the transfer request
 There can be one or more <error> elements, depending on the number of errors found.

Harvesting of information associated to the PGRFA from GLIS

When the Recipient's system receives the transfer request forwarded by GLIS, it should query GLIS for the information associated to each of the materials listed. For this, GLIS offers a query API described in the document "GLIS Query API". In the following, a brief description of the endpoint to be

used for harvesting information in the context of the transfer transaction is provided. Please refer to the document for further details.

The request to obtain the information associated to the DOI of a PGRFA is:

```
https://www.fao.org/glisapi/v1/pgrfas?doi=[doi]
```

where [doi] is the DOI of the PGRFA in question. The response is an XML object with the descriptors associated to the DOI as described in <http://www.fao.org/plant-treaty/areas-of-work/global-information-system/descriptors/en/>. The response is also available in JSON and more formats are being added, please refer to the Query API document for details.

Adding new targets to DOI

When new information is produced about a PGRFA already associated to a GLIS DOI, it is possible to use this message that implements the addition of a new target to an DOI already registered in GLIS.

The structure of the XML document to put into the HTTPS POST body is as follows

```
<?xml version="1.0" encoding="UTF-8" ?>
<addtargets username="[username]" password="[password]">
  <doi>[DOI]</doi>
  <targets>
    <target>*
      <url>[url]</url>
      <kws>
        <kw>[tkw]</kw>*
      </kws>
    </target>
    ...
  </targets>
</addtargets>
```

The <target> and <kw> elements can be repeated any number of times. However, the message refers to a single DOI, so the <doi> element must be present exactly once.

The placeholder's meaning is:

[DOI]	the DOI of the PGRFA to which the targets are being added. Must be present in GLIS. Use the DOI itself (i.e. 10.xxx/yyy), do not use prefixes doi: or https://doi.org/
[url]	the URL of the target web page or resource
[tkw]	the keyword code associated to the target, see Table 2 below. At least one keyword code must be present

Response

If the request passes the preliminary checks, GLIS validates the XML object included in the HTTPS POST and responds with a XML object as follows:

```
<?xml version="1.0" encoding="utf-8"?>
<response>
  <sampleid>[sampleID]</sampleid>
  <genus>[genus]</genus>
  <doi>[DOI]</doi>
  <error>[message]</error>
</response>
```

where:

[sampleid]	is the local sample identifier sent in the request
[genus]	is the genus of the PGRFA
[DOI]	is the DOI associated with the PGRFA upon registration
[message]	is the error message generated during the validation of the registration request

The <error> element is present if any problem is found with the request. If the message is malformed, the other elements may be missing due to the impossibility of properly parsing the request. Error messages are usually self-explanatory.

Coding tables

This section lists the codes used in the elements above unless a link is provided to some external reference site in the element description. Codes must be entered exactly as shown.

Table 1: [method]

Code	Description
acqu	Acquisition
ihcp	In-house copy
ihva	In-house variant
nodl	Novel distinct PGRFA
obna	Observation - Natural
obin	Observation - Inherited

Table 2: [tkw]

Code	Description
1	Passport data
1.1	Genealogy
1.2	Collection documents
2	Characterization
3	Evaluation
3.1	Chemical analysis
3.2	Abiotic stress
3.3	Biotic stress
3.4	Biochemical markers
3.5	Molecular markers
3.6	Cytological characters
3.7	Genomics
3.8	Phenomics
4	Environments
5	Multimedia

Table 3: [biostatus]

Code	Description
100	Wild
110	Natural
120	Semi-natural/wild
130	Semi-natural/sown
200	Weedy
300	Traditional cultivar/landrace
400	Breeding/research material
410	Breeder's line
411	Synthetic population
412	Hybrid
413	Founder stock/base population
414	Inbred line (parent of hybrid cultivar)
415	Segregating population
416	Clonal selection
420	Genetic stock
421	Mutant
422	Cytogenetic stocks
423	Other genetic stocks
500	Advanced or improved cultivar
600	GMO
999	Other

Table 4: [itype]

Code	Description
ark	ARK
genesysuuid	Genesys UUID
gmsid	GMS ID
lsid	LSID
purl	PURL
sgsvid	Global Seed Vault ID

Table 5: [mlsstatus]

Code	Description
0	Not available under the MLS
1	Available under the MLS
11	The PGRFA belongs to a crop listed in Annex I and is under the management and control of a Contracting Party to the Treaty and declared to be in the public domain
12	The sample is in a collection subject to an agreement concluded under Article 15 of the Treaty
13	The holder received the sample with SMTA
14	The holder has voluntarily placed the PGRFA into the MLS
15	The PGRFA is derived from, and distinct from, material previously received from the MLS,

	is still under development and not yet ready for commercialization, and may be made available at the discretion of the developer
--	--

Table 6: [source]

Code	Description
10	Wild habitat
11	Forest or woodland
12	Shrubland
13	Grassland
14	Desert or tundra
15	Acquatic habitat
20	Farm or cultivated habitat
21	Field
22	Orchard
23	Backyard, kitchen or home garden (urban, peri-urban or rural)
24	Fallow land
25	Pasture
26	Farm store
27	Threshing floor
28	Park
30	Market or shop
40	Institute, Experimental station, Research organization, Genebank
50	Seed company
60	Weedy, disturbed or ruderal habitat
61	Roadside
62	Field margin
99	Other

Table 7: Extensions to the ISO-3166 alpha-3 list of country codes

To address the historical or approximate nature of country information available in some cases, according to the ISO-3166 standard, the following user-defined and historical codes are also available in addition to the standard ones.

Name	Code
Alpine	XAL
Andes	XAN
Arabia	XAR
Australasia	XAA
Australia & New Zealand	XAZ
Benelux	XBE
Bengal	XBN
Cape Horn	XCH
Caribbean	XCR
Caspian	XCP
Central Africa	XCF
Central America	XCA
Czechoslovakia	CSK

East Africa	XEF
Eastern Europe	XEE
Far East	XFE
German Democratic Rep.	DDR
Germany, Federal Rep. of	BRD
Himalaya	XHM
Iberia	XIB
Mediterranean	XMD
Middle East	XME
New Hebrides	NHB
North Africa	XNF
North America	XNA
North-East Asia	XNE
Pacific Ocean	XPO
Panama Canal Zone	PCZ
Sahara	XSH
Scandinavia	XSC
Sea of Japan	XSJ
Serbia and Montenegro	SCG
South America	XSA
South East Asia	XAS
Southern Africa	XSF
Southern Europe	XSE
Union of Soviet Soc. Rep.	SUN
Upper Volta	HVO
West Africa	XWF
Western Europe	XWE
Yemen, Democratic	YMD
Yugoslavia	YUG