AIP Backup and Restore

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Background & Overview
AIP Backup & Restore doesn't yet work for Configurable Entities

Configurable Entities are not fully supported by AIP Backup & Restore. Since Entities are Items, their metadata and files can be exported/imported via AIPs. However, their relationships to other Entities cannot yet be exported (or imported) via AIPs. Therefore, restoring Entities via AIP Backup & Restore may result in accidental data loss (namely loss of relationships). See https://github.com/DSpace/DSpace/issues/2882 for more information. AIP Backup & Restore functionality only works with the Latest Version of Items

If you are using the Item Level Versioning functionality (disabled by default), you must be aware that this "Item Level Versioning" feature is not yet compatible with AIP Backup & Restore. Using them together may result in accidental data loss. Currently the AIPs that DSpace generates only store the latest version of an Item. Therefore, past versions of Items will always be lost when you perform a restore / replace using AIP tools.

Additional background information available in the Open Repositories 2010 Presentation entitled Improving DSpace Backups, Restores & Migrations

DSpace can backup and restore all of its contents as a set of AIP Files. This includes all Communities, Collections, Items, Groups and People in the system.

This feature came out of a requirement for DSpace to better integrate with DuraCloud, and other backup storage systems. One of these requirements is to be able to essentially "backup" local DSpace contents into the cloud (as a type of offsite backup), and "restore" those contents at a later time.

Essentially, this means DSpace can export the entire hierarchy (i.e. bitstreams, metadata and relationships between Communities/Collections/Items) into a relatively standard format (a METS-based, AIP format). This entire hierarchy can also be re-imported into DSpace in the same format (essentially a restore of that content in the same or different DSpace installation).

Benefits for the DSpace community:
- Allows one to more easily move entire Communities or Collections between DSpace instances.
- Allows for a potentially more consistent backup of this hierarchy (e.g. to DuraCloud, or just to your own local backup system), rather than relying on synchronizing a backup of your Database (stores metadata/relationships) and assetstore (stores files/bitstreams).
- Provides a way for people to more easily get their data out of DSpace (whatever the purpose may be).
- Provides a relatively standard format for people to migrate entire hierarchies (Communities/Collections) from one DSpace to another (or from another system into DSpace).

How does this differ from traditional DSpace Backups? Which Backup route is better?

Traditionally, it has always been recommended to backup and restore DSpace's database and files (also known as the "assetstore") separately. This is described in more detail in the Storage Layer section of the DSpace System Documentation. The traditional backup and restore route is still a recommended and supported option.
However, the new AIP Backup & Restore option seeks to try and resolve many of the complexities of a traditional backup and restore. The below table details some of the differences between these two valid Backup and Restore options.

<table>
<thead>
<tr>
<th>Supported Backup/Restore Types</th>
<th>Traditional Backup &amp; Restore (Database and Files)</th>
<th>AIP Backup &amp; Restore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can Backup &amp; Restore all DSpace Content easily</td>
<td>Yes (Requires two backups/restores – one for Database and one for Files)</td>
<td>Yes (Though, will not backup/restore items which are not officially &quot;in archive&quot;)</td>
</tr>
<tr>
<td>Can Backup &amp; Restore a Single Community/Collection/Item easily</td>
<td>No (It is possible, but requires a strong understanding of DSpace database structure &amp; folder organization in order to only backup &amp; restore metadata/files belonging to that single object)</td>
<td>Yes</td>
</tr>
<tr>
<td>Backups can be used to move one or more Community/Collection/Items to another DSpace system easily.</td>
<td>No (Again, it is possible, but requires a strong understanding of DSpace database structure &amp; folder organization in order to only move metadata/files belonging to that object)</td>
<td>Yes</td>
</tr>
<tr>
<td>Can Backup &amp; Restore Item Versions</td>
<td>Yes (Requires two backups/restores – one for Database and one for Files)</td>
<td>No (Currently, AIP Backup &amp; Restore is not fully compatible with Item Level Versioning. AIP Backup &amp; Restore can only backup/restore the latest version of an Item)</td>
</tr>
<tr>
<td>Can Backup &amp; Restore Configurable Entities</td>
<td>Yes (Requires two backups/restores – one for Database and one for Files)</td>
<td>No (Currently, AIP Backup &amp; Restore is not fully compatible with Configurable Entities. AIP Backup &amp; Restore can only backup/restore the metadata &amp; files of the Entity, but cannot backup/restore relationships to other Entities)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supported Object Types During Backup &amp; Restore</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supports backup/restore of all Communities/Collections/Items (including metadata, files, logos, etc.)</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of all People/Groups/Permissions</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of all Collection-specific Item Templates</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of all Collection Harvesting settings (only for Collections which pull in all Items via OAI-PMH or OAI-ORE)</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of all Withdrawn (but not deleted) Items</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of Item Mappings between Collections</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of all in-process, uncompleted Submissions (or those currently in an approval workflow)</td>
<td>Yes</td>
</tr>
<tr>
<td>Supports backup/restore of Items using custom Metadata Schemas &amp; Fields</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Based on your local institutions needs, you will want to choose the backup & restore process which is most appropriate to you. You may also find it beneficial to use both types of backups on different time schedules, in order to keep to a minimum the likelihood of losing your DSpace installation settings or its contents. For example, you may choose to perform a Traditional Backup once per week (to backup your local system configurations and customizations) and an AIP Backup on a daily basis. Alternatively, you may choose to perform daily Traditional Backups and only use the AIP Backup as a "permanent archives" option (perhaps performed on a weekly or monthly basis).

Don't Forget to Backup your Configurations and Customizations

If you choose to use the AIP Backup and Restore option, do not forget to also backup your local DSpace configurations and customizations. Depending on how you manage your own local DSpace, these configurations and customizations are likely in one or more of the following locations:

- \{dspace\} - The DSpace installation directory (Please note, if you also use the AIP Backup & Restore option, you do not need to backup your \{dspace\}/assetstore directory, as those files already exist in your AIPs).
- \{dspace-source\} - The DSpace source directory

How does this help backup your DSpace to remote storage or cloud services (like DuraCloud)?

While AIP Backup and Restore is primarily a way to export your DSpace content objects to a local filesystem (or mounted drive), it can also be used as the basis for ensuring your content is safely backed up in a remote location (e.g. DuraCloud or other cloud backup services).

Simply put, these AIPs can be generated and then replicated off to remote storage or a cloud backup service for safe keeping. You can then pull them down either as an entire set, or individually, in order to restore one or more objects into your DSpace instance. While you could simply backup your entire DSpace database and "assetstore" to a cloud service, you’d have to download the entire database backup again in order to restore any content. With AIPs, you can instead just download the individual AIP files you need (which can decrease your I/O costs, if any exist) for that restoration.

This upload/download of your AIPs to a backup location can be managed in a manual fashion (e.g. via your own custom code or shell scripts), or you can use a DSpace Replication Task Suite add-on to help ease this process.

The Replication Task Suite add-on for DSpace allows you the ability to backup and restore DSpace contents to/from AIPs via the DSpace Administrative Web Interface. It also includes "connectors" to the DuraCloud API, so you can configure it to automatically backup/retrieve your AIPs to/from DuraCloud. Installing this add-on means you can now easily backup and restore DSpace to DuraCloud (or other systems) simply via the DSpace Administrative Web Interface. More information on installing and configuring this add-on can be found on the Replication Task Suite page.

Makeup and Definition of AIPs

AIPs are Archival Information Packages

- AIP is a package describing one archival object in DSpace.
  - The archival object may be a single Item, Collection, Community, or Site (Site AIPs contain site-wide information). Bitstreams are included in an Item's AIP.
  - Each AIP is logically self-contained, can be restored without rest of the archive. (So you could restore a single Item, Collection or Community).
  - Collection or Community AIPs do not include all child objects (e.g. Items in those Collections or Communities), as each AIP only describes one object. However, these container AIPs do contain references (links) to all child objects. These references can be used by DSpace to automatically restore all referenced AIPs when restoring a Collection or Community.
  - AIPs are only generated for objects which are currently in the "in archive" state in DSpace. This means that in-progress, uncompleted submissions are not described in AIPs and cannot be restored after a disaster. Permanently removed objects will also no longer be exported as AIPs after their removal. However, withdrawn objects will continue to be exported as AIPs, since they are still considered under the "in archive" status.
  - AIPs with identical contents will always have identical checksums. This provides a basic means of validating whether the contents within an AIP have changed. For example, if a Collection's AIP has the same checksum at two different points in time, it means that Collection has not changed during that time period.
  - AIP profile favors completeness and accuracy rather than presenting the semantics of an object in a standard format. It conforms to the quirks of DSpace's internal object model rather than attempting to produce a universally understandable representation of the object.
  - When possible, an AIP tries to use common standards to express objects.
  - An AIP can serve as a DIP (Dissemination Information Package) or SIP (Submission Information Package), especially when transferring custody of objects to another DSpace implementation.
  - In contrast to SIP or DIP, the AIP should include all available DSpace structural and administrative metadata, and basic provenance information. AIPs also describe some basic system level information (e.g. Groups and People).

AIP Structure / Format

Generally speaking, an AIP is an Zip file containing a METS manifest and all related content bitstreams.
Running the Code

Exporting AIPs

Export Modes & Options

All AIP Exports are done by using the Dissemination Mode (-d option) of the packager command.

There are two types of AIP Dissemination you can perform:

- **Single AIP** (default, using -d option) - Exports just an AIP describing a single DSpace object. So, if you ran it in this default mode for a Collection, you’d just end up with a single Collection AIP (which would not include AIPs for all its child Items)
- **Hierarchy of AIPs** (using the -d --all or -d -a option) - Exports the requested AIP describing an object, plus the AIP for all child objects.

Some examples follow:
- For a Site - this would export all Communities, Collections & Items within the site into AIP files (in a provided directory)
- For a Community - this would export that Community and all SubCommunities, Collections and Items into AIP files (in a provided directory)
- For a Collection - this would export that Collection and all contained Items into AIP files (in a provided directory)
- For an Item – this just exports the Item into an AIP as normal (as it already contains its Bitstreams/Bundles by default)

Exporting just a single AIP

To export in single AIP mode (default), use this "packager" command template:

```
[dspace]/bin/dspace packager -d -t AIP -e <eperson> -i <handle> <file-path>
```

For example:

```
[dspace]/bin/dspace packager -d -t AIP -e admin@myu.edu -i 4321/4567 aip4567.zip
```

The above code will export the object of the given handle (4321/4567) into an AIP file named "aip4567.zip". This will not include any child objects for Communities or Collections.

Exporting AIP Hierarchy

To export an AIP hierarchy, use the -a (or --all) package parameter.

For example, use this 'packager' command template:

```
[dspace]/bin/dspace packager -d -a -t AIP -e <eperson> -i <handle> <file-path>
```

For example:

```
[dspace]/bin/dspace packager -d -a -t AIP -e admin@myu.edu -i 4321/4567 aip4567.zip
```

The above code will export the object of the given handle (4321/4567) into an AIP file named "aip4567.zip". In addition it would export all children objects to the same directory as the "aip4567.zip" file. The child AIP files are all named using the following format:

- **File Name Format**: `<Obj-Type>@<Handle-with-dashes>.zip`
  - e.g. COMMUNITY@123456789-1.zip, COLLECTION@123456789-2.zip, ITEM@123456789-200.zip
  - This general file naming convention ensures that you can easily locate an object to restore by its name (assuming you know its Object Type and Handle).
  - Alternatively, if object doesn't have a Handle, it uses this File Name Format: `<Obj-Type>@internal-id-<DSpace-ID>.zip` (e.g. ITEM@internal-id-234.zip)

AIPs are only generated for objects which are currently in the "in archive" state in DSpace. This means that in-progress, uncompleted submissions are not described in AIPs and cannot be restored after a disaster.

Exporting Entire Site

To export an entire DSpace Site, pass the packager the Handle `<site-handle-prefix>/0`. For example, if your site prefix is "4321", you'd run a command similar to the following:

```
[dspace]/bin/dspace packager -d -t AIP -e <eperson> -i <site-handle-prefix>/0 <file-path>
```

For example:

```
[dspace]/bin/dspace packager -d -t AIP -e admin@myu.edu -i 4321/0 aip4567.zip
```
Again, this would export the DSpace Site AIP into the file "sitewide-aip.zip", and export AIPs for all Communities, Collections and Items into the same directory as the Site AIP.

Ingesting / Restoring AIPs

Ingestion Modes & Options

Ingestion of AIPs is a bit more complex than Dissemination, as there are several different "modes" available:

1. **Submit/Ingest Mode** (\(-s\) option, default) – submit AIP(s) to DSpace in order to create a new object(s) (i.e. AIP is treated like a SIP – Submission Information Package)
2. **Restore Mode** (\(-r\) option) – restore pre-existing object(s) in DSpace based on AIP(s). This also attempts to restore all handles and relationships (parent/child objects). This is a specialized type of "submit", where the object is created with a known Handle, known UUID and known relationships.
3. **Replace Mode** (\(-r\) \(-f\) option) – replace existing object(s) in DSpace based on AIP(s). This also attempts to restore all handles and relationships (parent/child objects). This is a specialized type of "restore" where the contents of existing object(s) is replaced by the contents in the AIP(s). By default, if a normal "restore" finds the object already exists, it will back out (i.e. rollback all changes) and report which object already exists.

Again, like export, there are two types of AIP Ingestion you can perform (using any of the above modes):

- **Single AIP** (default) - Ingests just an AIP describing a single DSpace object. So, if you ran it in this default mode for a Collection AIP, you'd just create a DSpace Collection from the AIP (but not ingest any of its child objects)
- **Hierarchy of AIPs** (by including the \(--all\) or \(-a\) option after the mode) - Ingests the requested AIP describing an object, plus the AIP for all child objects. Some examples follow:
  - For a Site - this would ingest all Communities, Collections & Items based on the located AIP files
  - For a Community - this would ingest that Community and all SubCommunities, Collections and Items based on the located AIP files
  - For a Collection - this would ingest Collection and all contained Items based on the located AIP files
  - For an Item – this just ingest the Item (including all Bitstreams & Bundles) based on the AIP file.

The difference between "Submit" and "Restore/Replace" modes

It's worth understanding the primary differences between a Submission (specified by \(-s\) parameter) and a Restore (specified by \(-r\) parameter).

- **Submission Mode** (\(-s\) mode) - creates a new object (AIP is treated like a SIP)
  - By default, a new Handle is always assigned
  - However, you can force it to use the handle specified in the AIP by specifying \(-o\ ignoreHandle=false\) as one of your parameters
  - By default, a new Parent object must be specified (using the \(-p\) parameter). This is the location where the new object will be created.
  - However, you can force it to use the parent object specified in the AIP by specifying \(-o\ ignoreParent=false\) as one of your parameters
  - By default, will respect a Collection's Workflow process when you submit an Item to a Collection
  - However, you can specifically skip any workflow approval processes by specifying \(-v\) parameter.
  - Always adds a new Deposit License to Items
  - Always adds new DSpace System metadata to Items (includes new "dc.date.accessioned", "dc.date.available", "dc.date.issued" and "dc.description.provenance" entries)

- **Restore / Replace Mode** (\(-r\) mode) - restores a previously existing object (as if from a backup)
  - By default, the Handle specified in the AIP is restored
  - However, for restores, you can force a new handle to be generated by specifying \(-o\ ignoreHandle=true\) as one of your parameters. (NOTE: Doesn't work for replace mode as the new object always retains the handle of the replaced object)
  - By default, the object is restored under the Parent specified in the AIP
  - However, for restores, you can force it to restore under a different parent object by using the \(-p\) parameter. (NOTE: Doesn't work for replace mode, as the new object always retains the parent of the replaced object)
  - Always skips any Collection workflow approval processes when restoring/replacing an Item in a Collection
  - Never adds a new Deposit License to Items (rather it restores the previous deposit license, as long as it is stored in the AIP)
  - Never adds new DSpace System metadata to Items (rather it just restores the metadata as specified in the AIP)

Changing Submission/Restore Behavior

It is possible to change some of the default behaviors of both the Submission and Restore/Replace Modes. Please see the Additional Packager Options section below for a listing of command-line options that allow you to override some of the default settings described above.

Submitting AIP(s) to create a new object

The Submission mode (\(-s\)) always creates a new object with a newly assigned handle. In addition by default it respects all existing Collection approval workflows (so items may require approval unless the workflow is skipped by using the \(-v\) option). For information about how the "Submission Mode" differs from the "Replace / Restore mode", see The difference between "Submit" and "Restore/Replace" modes above.
Submitting a Single AIP

AIPs treated as SIPs

This option allows you to essentially use an AIP as a SIP (Submission Information Package). The default settings will create a new DSpace object (with a new handle and a new parent object, if specified) from your AIP.

To ingest a single AIP and create a new DSpace object under a parent of your choice, specify the -p (or --parent) package parameter to the command. Also, note that you are running the packager in -s (submit) mode.

NOTE: This only ingests the single AIP specified. It does not ingest all children objects.

```
[dspace]/bin/dspace packager -s -t AIP -e <eperson> -p <parent-handle> <file-path>
```

If you leave out the -p parameter, the AIP package ingester will attempt to install the AIP under the same parent it had before. As you are also specifying the -s (submit) parameter, the packager will assume you want a new Handle to be assigned (as you are effectively specifying that you are submitting a new object). If you want the object to retain the Handle specified in the AIP, you can specify the --ignoreHandle=false option to force the packager to not ignore the Handle specified in the AIP.

Submitting an AIP Hierarchy

AIPs treated as SIPs

This option allows you to essentially use a set of AIPs as SIPs (Submission Information Packages). The default settings will create a new DSpace object (with a new handle and a new parent object, if specified) from each AIP.

To ingest an AIP hierarchy from a directory of AIPs, use the --all package parameter.

For example, use this 'packager' command template:

```
[dspace]/bin/dspace packager -s -a -t AIP -e <eperson> -p <parent-handle> <file-path>
```

for example:

```
[dspace]/bin/dspace packager -s -a -t AIP -e admin@myu.edu -p 4321/12 aip4567.zip
```

The above command will ingest the package named "aip4567.zip" as a child of the specified Parent Object (handle="4321/12"). The resulting object is assigned a new Handle (since -s is specified). In addition, any child AIPs referenced by "aip4567.zip" are also recursively ingested (a new Handle is also assigned for each child AIP).

Another example – Ingesting a Top-Level Community (by using the Site Handle, <site-handle-prefix>/0):

```
[dspace]/bin/dspace packager -s -a -t AIP -e admin@myu.edu -p 4321/0 community-aip.zip
```

The above command will ingest the package named "community-aip.zip" as a top-level community (i.e. the specified parent is "4321/0" which is a Site Handle). Again, the resulting object is assigned a new Handle. In addition, any child AIPs referenced by "community-aip.zip" are also recursively ingested (a new Handle is also assigned for each child AIP).

May want to skip Collection Approvals Workflows

Please note: If you are submitting a larger amount of content (e.g. multiple Communities/Collections) to your DSpace, you may want to tell the 'packager' command to skip over any existing Collection approval workflows by using the -w flag. By default, all Collection approval workflows will be respected. This means if the content you are submitting includes a Collection with an enabled workflow, you may see the following occur:

1. First, the Collection will be created & its workflow enabled
2. Second, each Item belonging to that Collection will be created & placed into the workflow approval process

Therefore, if this content has already received some level of approval, you may want to submit it using the -w flag, which will skip any workflow approval processes. For more information, see Submitting AIP(s) while skipping any Collection Approval Workflows.
Item Mappings may not be maintained when submitting an AIP hierarchy

When an Item is mapped to one or more Collections, this mapping is recorded in the AIP using the mapped Collection's handle. Unfortunately, since the submission mode (-s) assigns new handles to all objects in the hierarchy, this may mean that the mapped Collection's handle will have changed (or even that a different Collection will be available at the original mapped Collection's handle). DSpace does not have a way to uniquely identify Collections other than by handle, which means that item mappings are only able to be retained when the Collection handle is also retained.

If you encounter this issue, there are a few possible workarounds:

1. Use the restore/replace mode (-r) instead, as it will retain existing Collection Handles. Unfortunately though, this may not work if the content is being moved from a Test DSpace to a Production DSpace, as these existing handles may not be valid.
2. OR, use the submission mode with the "-o ignoreHandle=false". This will also retain existing Collection Handles. Unfortunately though, this may not work if the content is being moved from a Test DSpace to a Production DSpace, as these existing handles may not be valid.
3. OR, remove all existing Item Mappings and re-export AIPs (without Item Mappings). Then, import the hierarchy into the new DSpace instance (again without Item Mappings). Finally, recreate the necessary Item Mappings using a different tool, e.g. the Batch Metadata Editing tool supports bulk editing of Collection memberships/mappings.

Missing Groups or EPeople cannot be created when submitting an individual Community or Collection AIP

Please note, if you are using AIPs to move an entire Community or Collection from one DSpace to another, there is a known issue (see https://github.com/DSpace/DSpace/issues/4477) that the new DSpace instance will be unable to (re-)create any DSpace Groups or EPeople which are referenced by a Community or Collection AIP. The reason is that the Community or Collection AIP itself doesn't contain enough information to create those Groups or EPeople (rather than info is stored in the SITE AIP, for usage during Full Site Restores).

However, there are two possible ways to get around this known issue:

- **EITHER**, you can manually recreate all referenced Groups/EPeople in the new DSpace that you are submitting the Community or Collection AIP into.
- **OR**, you can temporarily disable the import of Group/EPeople information when submitting the Community or Collection AIP to the new DSpace. This would mean that after you submit the AIP to the new DSpace, you'd have to manually go in and add in any special permissions (as needed). To disable the import of Group/EPeople information, add these settings to your dspace.cfg file, and re-run the submission of the AIP with these settings in place:

```
mets.dspaceAIP.ingest.crosswalk.METSRIGHTS = NIL
mets.dspaceAIP.ingest.crosswalk.DSPACE-ROLES = NIL
```

- Don't forget to remove these settings after you import your Community or Collection AIP. **Leaving them in place will mean that every time you import an AIP, all of its Group/EPeople/Permissions would be ignored.**

Submitting AIP(s) while skipping any Collection Approval Workflows

By default, the Submission mode (-s) always respects existing Collection approval workflows. So, if a Collection has a workflow, then a newly submitted Item will be placed into that workflow process (rather than immediately appearing in DSpace).

However, if you'd like to skip all workflow approval processes you can use the -w flag to do so. For example, the following command will skip any Collection approval workflows and immediately add the Item to a Collection.

```
[dspace]/bin/dspace packager -s -w -t AIP -e <eperson> -p <parent-handle> <file-path>
```

This -w flag may also be used when Submitting an AIP Hierarchy. For example, if you are migrating one or more Collections/Communities from one DSpace to another, you may choose to submit those AIPs with the -w option enabled. This will ensure that, if a Collection has a workflow approval process enabled, all its Items are available immediately rather than being all placed into the workflow approval process.

Restoring/Replacing using AIP(s)

**Restoring** is slightly different than just submitting. When restoring, we make every attempt to restore the object as it used to be (including its handle, parent object, etc.). For more information about how the "Replace/Restore Mode" differs from the "Submit mode", see The difference between "Submit" and "Restore/Replace" modes above.

There are currently three restore modes:

1. **Default Restore Mode** (-r) = Attempt to restore object (and optionally children). Rollback all changes if any object is found to already exist.
2. **Restore, Keep Existing Mode** (-r -k) = Attempt to restore object (and optionally children). If an object is found to already exist, skip over it (and all children objects), and continue to restore all other non-existing objects.
3. **Force Replace Mode** (-r -f) = Restore an object (and optionally children) and overwrite any existing objects in DSpace. Therefore, if an object is found to already exist in DSpace, its contents are replaced by the contents of the AIP. **WARNING**: This mode is potentially dangerous as it will permanently destroy any object contents that do not currently exist in the AIP. You may want to perform a secondary backup, unless you are sure you know what you are doing!

Default Restore Mode

By default, the restore mode (-r option) will throw an error and rollback all changes if any object is found to already exist. The user will be informed if which object already exists within their DSpace installation.
**Restore a Single AIP:** Use this 'packager' command template to restore a single object from an AIP (not including any child objects):

```
[dspace]/bin/dspace packager -r -t AIP -e <eperson> <AIP-file-path>
```

**Restore a Hierarchy of AIPs:** Use this 'packager' command template to restore an object from an AIP along with all child objects (from their AIPs):

```
[dspace]/bin/dspace packager -r -a -t AIP -e <eperson> <AIP-file-path>
```

For example:

```
[dspace]/bin/dspace packager -r -a -t AIP -e admin@myu.edu aip4567.zip
```

Notice that unlike -s option (for submission/ingesting), the -r option does not require the Parent Object (-p option) to be specified if it can be determined from the package itself.

In the above example, the package "aip4567.zip" is restored to the DSpace installation with the Handle provided within the package itself (and added as a child of the parent object specified within the package itself). In addition, any child AIPs referenced by "aip4567.zip" are also recursively ingested (the -a option specifies to also restore all child AIPs). They are also restored with the Handles & Parent Objects provided with their package. If any object is found to already exist, all changes are rolled back (i.e. nothing is restored to DSpace).

Highly Recommended to Update Database Sequences after a Large Restore

In some cases, when you restore a large amount of content to your DSpace, the internal database counts (called "sequences") may get out of sync with the Handles of the content you just restored. As a best practice, it is highly recommended to always re-run the "update-sequences" script on your DSpace database after a larger scale restore. This database script should be run while DSpace is stopped (you may either stop Tomcat or just the DSpace webapps). PostgreSQL/Oracle must be running. Simply run:

```
[dspace]/bin/dspace database update-sequences
```

More Information on using Default Restore Mode with Community/Collection AIPs

- Using the Default Restore Mode without the -a option, will only restore the metadata for that specific Community or Collection. No child objects will be restored.
- Using the Default Restore Mode with the -a option, will only successfully restore a Community or Collection if that object along with any child objects (Sub-Communities, Collections or Items) do not already exist. In other words, if any objects belonging to that Community or Collection already exist in DSpace, the Default Restore Mode will report an error that those object(s) could not be recreated. If you encounter this situation, you will need to perform the restore using either the Restore, Keep Existing Mode or the Force Replace Mode (depending on whether you want to keep or replace those existing child objects).

**Restore, Keep Existing Mode**

When the "Keep Existing" flag (-k option) is specified, the restore will attempt to skip over any objects found to already exist. It will report to the user that the object was found to exist (and was not modified or changed). It will then continue to restore all objects which do not already exist.

One special case to note: If a Collection or Community is found to already exist, its child objects are also skipped over. So, this mode will not auto-restore items to an existing Collection.

**Restore a Hierarchy of AIPs:** Use this 'packager' command template to restore an object from an AIP along with all child objects (from their AIPs):

```
[dspace]/bin/dspace packager -r -a -k -t AIP -e <eperson> <AIP-file-path>
```

For example:

```
[dspace]/bin/dspace packager -r -a -k -t AIP -e admin@myu.edu aip4567.zip
```

In the above example, the package "aip4567.zip" is restored to the DSpace installation with the Handle provided within the package itself (and added as a child of the parent object specified within the package itself). In addition, any child AIPs referenced by "aip4567.zip" are also recursively restored (the -a option specifies to also restore all child AIPs). They are also restored with the Handles & Parent Objects provided with their package. If any object is found to already exist, it is skipped over (child objects are also skipped). All non-existing objects are restored.

**Force Replace Mode**

When the "Force Replace" flag (-f option) is specified, the restore will overwrite any objects found to already exist in DSpace. In other words, existing content is deleted and then replaced by the contents of the AIP(s).
May also be useful in some specific restoration scenarios

This mode may also be used to restore missing objects which refer to existing objects. For example, if you are restoring a missing Collection which had existing Items linked to it, you can use this mode to auto-restore the Collection and update those existing Items so that they again link back to the newly restored Collection.

Potential for Data Loss

Because this mode actually destroys existing content in DSpace, it is potentially dangerous and may result in data loss! You may wish to perform a secondary full backup (assetstore files & database) before attempting to replace any existing object(s) in DSpace.

Replace using a Single AIP: Use this ‘packager’ command template to replace a single object from an AIP (not including any child objects):

```
[dspace]/bin/dspace packager -r -f -t AIP -e <eperson> <AIP-file-path>
```

Replace using a Hierarchy of AIPs: Use this ‘packager’ command template to replace an object from an AIP along with all child objects (from their AIPs):

```
[dspace]/bin/dspace packager -r -a -f -t AIP -e <eperson> <AIP-file-path>
```

For example:

```
[dspace]/bin/dspace packager -r -a -f -t AIP -e admin@myu.edu aip4567.zip
```

In the above example, the package "aip4567.zip" is restored to the DSpace installation with the Handle provided within the package itself (and added as a child of the parent object specified within the package itself). In addition, any child AIPs referenced by *aip4567.zip* are also recursively ingested. They are also restored with the Handles & Parent Objects provided with their package. If any object is found to already exist, its contents are replaced by the contents of the appropriate AIP.

If any error occurs, the script attempts to rollback the entire replacement process.

Restoring Entire Site

In order to restore an entire Site from a set of AIPs, you must do the following:

1. Install a completely “fresh” version of DSpace by following the Installation instructions in the DSpace Manual
   - At this point, you should have a completely empty, but fully-functional DSpace installation. You will need to create an initial Administrator user in order to perform this restore (as a full-restore can only be performed by a DSpace Administrator).
2. Once DSpace is installed, run the following command to restore all its contents from AIPs

   ```
   [dspace]/bin/dspace packager -r -a -f -t AIP -e <eperson> -i <site-handle-prefix>/0 -o skipIfParentMissing=true /full/path/to/your/site-aip.zip
   ```

   a. While the "-o skipIfParentMissing=true" flag is optional, it is often necessary whenever you are performing a large hierarchical site restoration. Please see the Additional Packager Options section below.

Please note the following about the above restore command:

- Notice that you are running this command in “Force Replace” mode (-r -f). This is necessary as your empty DSpace install will already include a few default groups (Administrators and Anonymous) and your initial administrative user. You need to replace these groups in order to restore your prior DSpace contents completely.
- `<eperson>` should be replaced with the Email Address of the initial Administrator (who you created when you reinstalled DSpace).
- `<site-handle-prefix>` should be replaced with your DSpace site's assigned Handle Prefix. This is equivalent to the `handle.prefix` setting in your `dspace.cfg`
- `/full/path/to/your/site-aip.zip` is the full path to the AIP file which represents your DSpace SITE. This file will be named whatever you named it when you actually exported your entire site. All other AIPs are assumed to be referenced from this SITE AIP (in most cases, they should be in the same directory as that SITE AIP).

Highly Recommended to Update Database Sequences after a Large Restore

In some cases, when you restore a large amount of content to your DSpace, the internal database counts (called "sequences") may get out of sync with the Handles of the content you just restored. As a best practice, it is highly recommended to always re-run the "update-sequences" script on your DSpace database after a larger scale restore. This database script should be run while DSpace is stopped (you may either stop Tomcat or just the DSpace webapps). PostgreSQL/Oracle must be running. Simply run:

```
[dspace]/bin/dspace database update-sequences
```

Cleaning up from a failed import
Sometimes your packager import of AIP packages can fail, due to lack of memory (see below for advice on better performance, please use JAVA_OPTS to set your memory higher than the default). If that happens, DSpace by design will leave the bitstreams it did import successfully, but they will be orphaned, and will just occupy space in your assetstore. The standard DSpace cleanup cron job will clean up these orphaned bitstreams, however, you can also clean them up manually by running the following command:

```
Clean up after a failed import

[dspace]/bin/dspace cleanup -v
```

**Performance considerations**

When importing large structures like the whole site or a large collection/community, keep in mind that this can require a lot of memory, more than the default amount of heap allocated to the command-line launcher (256 Mb: JAVA_OPTS=-Xmx256m -Dfile.encoding=UTF-8). This memory must be allocated in addition to the normal amount of memory allocated to Tomcat. For example, a site of 2500 fulltext items (2 Gb altogether) requires 5 Gb of maximum heap space and takes around 1 hour, including import and indexing.

You can raise the limit for a single run of the packager command by specifying memory options in the JAVA_OPTS environment variable, e.g.:

```
JAVA_OPTS=-Xmx4096m -Dfile.encoding=UTF-8 /dspace/bin/dspace packager -u -r -a -f -t AIP -e dspace@example.com -i 123456789/0 sitewide-aip.zip
```

If the importer runs out of heap memory, it will crash either with "java.lang.OutOfMemoryError: GC overhead limit exceeded", which can be suppressed by adding ";-XX:-UseGCOverheadLimit" to JAVA_OPTS, or with "java.lang.OutOfMemoryError: Java heap space". You can increase the allocated heap memory and try again, but keep in mind that although no changes were made in the database, the unsuccessfully imported files are still left in the assetstore (see [https://github.com/DSpace/DSpace/issues/5593](https://github.com/DSpace/DSpace/issues/5593)).

**Disable User Interaction for Cron**

If you wish to run any of the following commands from a cron job (or similar), then you may wish to disable all user interaction using the -u (--no-user-interaction) flag. For example, supposing you wanted to perform a full Site Backup (see Exporting Entire Site above) via a cronjob, you could simply run that command passing it the "-u" flage like this:

```
# Perform a full site backup to AIPs(with user interaction disabled) every Sunday at 1:00AM
# NOTE: Make sure to replace "123456789" with your actual Handle Prefix, and "admin@myu.edu" with your Administrator account email.
0 1 * * * [dspace]/bin/dspace packager -u -d -a -t AIP -e admin@myu.edu -i 123456789/0 [full-path-to-backup-folder]/sitewide-aip.zip
```

**Command Line Reference**

The following flags are valid to pass to the [dspace]/bin/dspace packager command:

<table>
<thead>
<tr>
<th>Flag</th>
<th>Ingest or Export</th>
<th>Description / Usage</th>
</tr>
</thead>
</table>
| -a (--all) | both ingest and export | *For Ingest: recursively ingest all child AIPs (referenced from this AIP).*  
  *For Export: recursively export all child objects (referenced from this parent object)*  

| -d (--disseminate) | export-only | This flag simply triggers the export of AIPs from the system. See Exporting AIPs |
| -e (--eperson) [email-address] | ingest-only | The email address of the EPerson who is ingesting the AIPs. Oftentimes this should be an Administrative account. |
| -f (--force-replace) | ingest-only | Ingest the AIPs in "Force Replace Mode" (must be specified in conjunction with --r flag), where existing objects will be replaced by the contents of the AIP. |
Additional Packager Options

In addition to the various "modes" settings described under "Running the Code" above, the AIP Packager supports the following packager options. These options allow you to better tweak how your AIPs are processed (especially during ingests/restores/replaces).

<table>
<thead>
<tr>
<th>Option</th>
<th>Ingest or Export</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>createMetadataFields= [value]</code></td>
<td>ingest-only</td>
<td>true</td>
<td>Tells the AIP ingester to automatically create any metadata fields which are found to be missing from the DSpace Metadata Registry. When 'true', this means as each AIP is ingested, new fields may be added to the DSpace Metadata Registry if they don't already exist. When 'false', an AIP ingest will fail if it encounters a metadata field that doesn't exist in the DSpace Metadata Registry. (NOTE: This will not create missing DSpace Metadata Schemas. If a schema is found to be missing, the ingest will always fail.)</td>
</tr>
</tbody>
</table>
| `filterBundles= [value]`    | export-only      | defaults to exporting all Bundles | This option can be used to limit the Bundles which are exported to AIPs for each DSpace Item. By default, all file Bundles will be exported into Item AIPs. You could use this option to limit the size of AIPs by only exporting certain Bundles. WARNING: any bundles not included in AIPs will obviously be unable to be restored. This option can be run in two ways:
  - Exclude Bundles: By default, you can provide a comma-separated list of bundles to be excluded from AIPs (e.g. "TEXT, THUMBNAIL")
  - Include Bundles: If you prepend the list with the "*" symbol, then the list specifies the bundles to be included in AIPs (e.g. "*ORIGINAL/LICENSE" would only include those two bundles). This second option is identical to using "includeBundles" option described below.
  (NOTE: If you choose to no longer export LICENSE or CC_LICENSE bundles, you will also need to disable the License Dissemination Crosswalks in the aip.disseminate.rightsMD configuration for the changes to take affect) |
| `ignoreHandle= [value]`    | ingest-only      | Restore / Replace Mode defaults to 'false', Submit Mode defaults to 'true' | If 'true', the AIP ingester will ignore any Handle specified in the AIP itself, and instead create a new Handle during the ingest process (this is the default when running in Submit mode, using the --s flag). If 'false', the AIP ingester attempts to restore the Handles specified in the AIP (this is the default when running in Restore/replace mode, using the --r flag). |
### How to use additional options

These options can be passed in two main ways:

**From the Command Line**

From the command-line, you can add the option to your command by using the `-o` or `--option` parameter.

```
[dspace]/bin/dspace packager -r -a -t AIP -o [option1]=[value] -o [option2]=[value] -e admin@myu.edu aip4567.zip
```

For example:

```
[dspace]/bin/dspace packager -r -a -t AIP -o ignoreParent=false -o createMetadataFields=false -e admin@myu.edu aip4567.zip
```

**Via the Java API call**

If you are programmatically calling the `org.dspace.content.packager.DSpaceAIPIngest` from your own custom script, you can specify these options via the `org.dspace.content.packager.PackageParameters` class.

As a basic example:
Configuration in 'dspace.cfg'

The following new configurations relate to AIPs:

**AIP Metadata Dissemination Configurations**

The following configurations allow you to specify what metadata is stored within each METS-based AIP. In 'dspace.cfg', the general format for each of these settings is:

- `aip.disseminate.<setting> = <DSpace-crosswalk-name> [, ...]`
  - `<setting>` is the setting name (see below for the full list of valid settings)
  - `<DSpace-crosswalk-name>` is required. It specifies the name of the DSpace Crosswalk which should be used to generate this metadata.
  - `<mdType>` is optional. It allows you to specify the value of the @MDTYPE attribute in the corresponding METS element.
  - `<label-for-METS> = <DSpace-crosswalk-name>` may be specified for each setting

**AIP Metadata Recommendations**

It is recommended to **minimally** use the default settings when generating AIPs. DSpace can only restore information that is included within an AIP. Therefore, if you choose to no longer include some information in an AIP, DSpace will no longer be able to restore that information from an AIP backup.

The default settings in 'dspace.cfg' are:

- `aip.disseminate.techMD - Lists the DSpace Crosswalks (by name) which should be called to populate the <techMD> section of the METS file within the AIP (Default: DSPACE-TECHMD)`
  - The DSPACE-TECHMD crosswalk generates technical metadata (in DIM format) for the object specified by the AIP
  - The DIM crosswalk can only restore permissions, and cannot re-create Groups or EPeople

- `aip.disseminate.rightsMD - Lists the DSpace Crosswalks (by name) which should be called to populate the <rightsMD> section of the METS file within the AIP (Default: None)`
  - The METSRights crosswalk ensures that Permissions/Rights on DSpace Objects (Communities, Collections, Items or Bitstreams) are referenced/stored in AIP. Using this crosswalk means that AIPs can be used to restore permissions that a particular Group or Person had on a DSpace Object. (NOTE: The METSRights crosswalk should always be used in conjunction with the DSPACE-ROLES crosswalk.)

- `aip.disseminate.dmd - Lists the DSpace Crosswalks (by name) which should be called to populate the <dmdSec> section of the METS file within the AIP (Default: MODS, DMD)`
  - The MODS crosswalk translates the DSpace descriptive metadata (for this object) into MODS. As MODS is a relatively "standard" metadata schema, it may be useful to include a copy of MODS metadata in your AIPs if you should ever want to import them into another (non-DSpace) system.
  - The DIM crosswalk just translates the DSpace internal descriptive metadata into an XML format. This XML format is proprietary to DSpace, but stores the metadata in a format similar to Qualified Dublin Core.

**AIP Ingestion Metadata Crosswalk Configurations**

The following configurations allow you to specify what DSpace Crosswalks are used during the ingestion/restoration of AIPs. These configurations also allow you to ignore areas of the METS file (in the AIP) if you do not want that area to be restored.

In 'dspace.cfg', the general format for each of these settings is:

- `mets.dspaceAIP.ingest.crosswalk.<mdType> = <DSpace-crosswalk-name>`
  - `<mdType>` is the type of metadata as specified in the METS file. This corresponds to the value of the @MDTYPE attribute (of that metadata section in the METS). When the @MDTYPE attribute is "OTHER", then the `<mdType>` corresponds to the @OTHERMDTYPE attribute value.
  - `<DSpace-crosswalk-name>` specifies the name of the DSpace Crosswalk which should be used to ingest this metadata into DSpace.
  - You can specify the "NULLSTREAM" crosswalk if you specifically want this metadata to be ignored (and skipped over during ingestion).

By default, the settings in 'dspace.cfg' are:

```java
PackageParameters params = new PackageParameters;
params.addProperty("createMetadataFields", "false");
params.addProperty("ignoreParent", "true");
```
The above settings tell the ingester to ignore any metadata sections which reference DSpace Deposit Licenses or Creative Commons Licenses. These metadata sections can be safely ignored as long as the "LICENSE" and "CC_LICENSE" bundles are included in AIPs (which is the default setting). As the Licenses are included in those Bundles, they will already be restored when restoring the bundle contents.

More Info on Default Crosswalks used

If unspecified in the above settings, the AIP ingester will automatically use the Crosswalk which is named the same as the @MDTYPE or @OTHERMDTYPE attribute for the metadata section. For example, a metadata section with an @MDTYPE="PREMIS" will be processed by the DSpace Crosswalk named "PREMIS".

AIP Ingestion EPerson Configurations

The following setting determines whether the AIP Ingester should create an EPerson (if necessary) when attempting to restore or ingest an Item whose Submitter cannot be located in the system. By default it is set to "false", as for AIPs the creation of EPeople (and Groups) is generally handled by the DSPA CE-ROLES crosswalk (see #AIP Metadata Dissemination Configurations for more info on DSPA-ROLES crosswalk.)

• mets.dspaceAIP.ingest.createSubmitter = false

AIP Configurations To Improve Ingestion Speed while Validating

It is recommended to validate all AIPs on ingestion (when possible). But validation can be extremely slow, as each validation request first must download all referenced Schema documents from various locations on the web (sometimes as many as 10 schemas may be necessary to download in order to validate a single METS file). To make matters worse, the same schema will be re-downloaded each time it is used (i.e. it is not cached locally). So, if you are validating just 20 METS files which each reference 10 schemas, that results in 200 download requests.

In order to perform validations in a speedy fashion, you can pull down a local copy of all schemas. Validation will then use this local cache, which can sometimes increase the speed up to 10 x.

To use a local cache of XML schemas when validating, use the following settings in ‘dspace.cfg’. The general format is:

• mets.xsd.<abbreviation> = <namespace> <local-file-name>
  • <abbreviation> is a unique abbreviation (of your choice) for this schema
  • <namespace> is the Schema namespace
  • <local-file-name> the full name of the cached schema file (which should reside in your [dspace]/config/schemas/ directory, by default this directory does not exist – you will need to create it)

The default settings are all commented out. But, they provide a full listing of all schemas currently used during validation of AIPs. In order to utilize them, uncomment the settings, download the appropriate schema file, and save it to your [dspace]/config/schemas/ directory (by default this directory does not exist – you will need to create it) using the specified file name:

#mets.xsd.mets = http://www.loc.gov/METS/mets.xsd
#mets.xsd.xlink = http://www.w3.org/1999/xlink xlink.xsd
#mets.xsd.mods = http://www.loc.gov/mods/v3 mods.xsd
#mets.xsd.xml = http://www.w3.org/XML/1998/namespace xml.xsd
#mets.xsd.dc = http://purl.org/dc/elements/1.1/ dc.xsd
#mets.xsd.dcterms = http://purl.org/dc/terms/ dcterms.xsd
#mets.xsd.premis = http://www.loc.gov/standards/premis PREMIS.xsd
#mets.xsd.premisObject = http://www.loc.gov/standards/premis PREMIS-Object.xsd
#mets.xsd.premisEvent = http://www.loc.gov/standards/premis PREMIS-Event.xsd
#mets.xsd.premisAgent = http://www.loc.gov/standards/premis PREMIS-Agent.xsd

Common Issues or Error Messages

The below table lists common fixes to issues you may encounter when backing up or restoring objects using AIP Backup and Restore.

<table>
<thead>
<tr>
<th>Issue / Error Message</th>
<th>How to Fix this Problem</th>
</tr>
</thead>
</table>


| Ingest/Restore Error: "Group Administrator already exists" | If you receive this problem, you are likely attempting to Restore an Entire Site, but are not running the command in Force Replace Mode (`-f`). Please see the section on Restoring an Entire Site for more details on the flags you should be using. |
| Ingest/Restore Error: "Unknown Metadata Schema encountered (mycustomschema)" | If you receive this problem, one or more of your Items is using a custom metadata schema which DSpace is currently not aware of (in the example, the schema is named "mycustomschema"). Because DSpace AIPs do not contain enough details to recreate the missing Metadata Schema, you must create it manually via the DSpace Admin UI. **Please note that you only need to create the Schema. You do not need to manually create all the fields belonging to that schema, as DSpace will do that for you as it restores each AIP.** Once the schema is created in DSpace, re-run your restore command. DSpace will automatically re-create all fields belonging to that custom metadata schema as it restores each Item that uses that schema. |
| Ingest Error: "Could not find a parent DSpaceObject referenced as 'xxx/xxx'" | When you encounter this error message it means that an object could not be ingested/restored as it belongs to a parent object which doesn't currently exist in your DSpace instance. During a full restore process, this error can be skipped over and treated as a warning by specifying the `-o skipIfParentMissing=true` option (see **Additional Packager Options**). If you have a larger number of Items which are mapped to multiple Collections, the AIP Ingestor will sometimes attempt to restore an item mapping before the Collection itself has been restored (thus throwing this error). Luckily, this is not anything to be concerned about. As soon as the Collection is restored, the Item Mapping which caused the error will also be automatically restored. So, if you encounter this error during a full restore, it is safe to bypass this error message using the `-o skipIfParentMissing=true` option. All your Item Mappings should still be restored correctly. |
| Submit Error: PSQLException: ERROR: duplicate key value violates unique constraint "handle_key" | This error means that while submitting one or more AIPs, DSpace encountered a Handle conflict. This is a general error the may occur in DSpace if your Handle sequence has somehow become out-of-date. However, it's easy to fix. Just run the `[dspace]/bin/dspace database update-sequences` |