GIFT-Cloud

A secure data storage and collaboration platform

Technical Manual
Version 1.6

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1 Introduction

GIFT-Cloud is a platform for securely sharing medical imaging data for use in academic research. It was developed as part of the GIFT-Surg project, by the Translational Imaging Group at University College London (UCL) [1].

Data are anonymised and hosted on a dedicated server. Users may view and download data by logging into a secure website, or by using GIFT-Cloud compatible software. Users can upload new data using the GIFT-Cloud Uploader software. This automatically anonymises data before upload, and provide PACS integration making it suitable for use in a hospital environment.

GIFT-Cloud is built using XNAT, a widely-used open source imaging informatics platform developed by the Neuroinformatics Research Group (NRG) at Washington University [2][3].

GIFT-Surg is funded by the Welcome Trust and the Engineering and Physical Sciences Research Council, and is a collaboration between UCL, Katholieke Universiteit Leuven (KU Leuven), University College Hospital (UCLH), Great Ormond Street Hospital (GOSH), and Universitaire Ziekenhuizen Leuven (UZ Leuven).

2 Disclaimer

GIFT-Cloud is intended for academic research use only. It is not permitted to use GIFT-Cloud for diagnosis, treatment planning, or any other purpose that can impact on patient care.

3 How to access GIFT-Cloud

Data for the GIFT-Surg project are hosted on a dedicated GIFT-Cloud server at UCL, and can be accessed using the website or compatible client software.

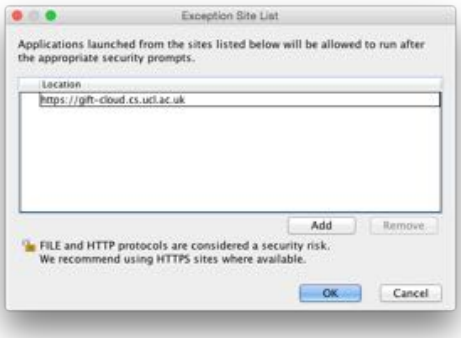
The server can be accessed from anywhere within the UCL and KUL networks. Access from other collaborating institutions can be arranged by the GIFT-Cloud administrators as required.

Before you use GIFT-Cloud for the first time, you may need to adjust the security settings for Java and for your web browser. Some features may not work if you do not do this.

Configuring JAVA

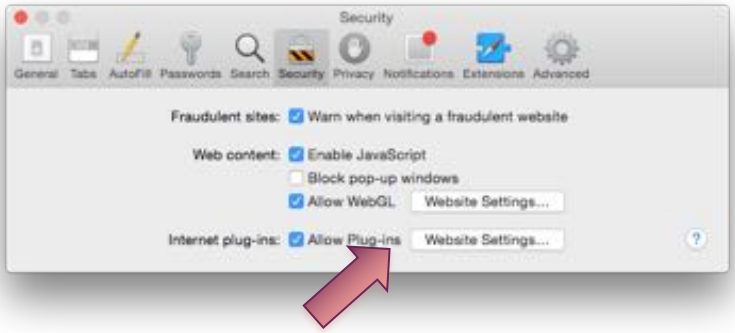
First you need to allow your browser to run GIFT-Cloud Java code:

- Install Java if is not already installed.
- Open the **Java Control Panel**
  - *Mac OSX: System Preferences > Java*
  - *Windows XP: Start > Control Panel > Java*
  - *Windows 7: Start > Control Panel, then enter Java Control Panel in the **Control Panel Search***
  - *Windows 8: search for Java Control Panel*
- Go to the **Security** tab.
- Ensure there is a tick next to **Enable Java content in the browser**.
- Set the Security level to **High**.
- Next to the **Exception Site List**, click the Edit Site List button. Then click **Add**. Enter https://gift-cloud.cs.ucl.ac.uk and click **OK**

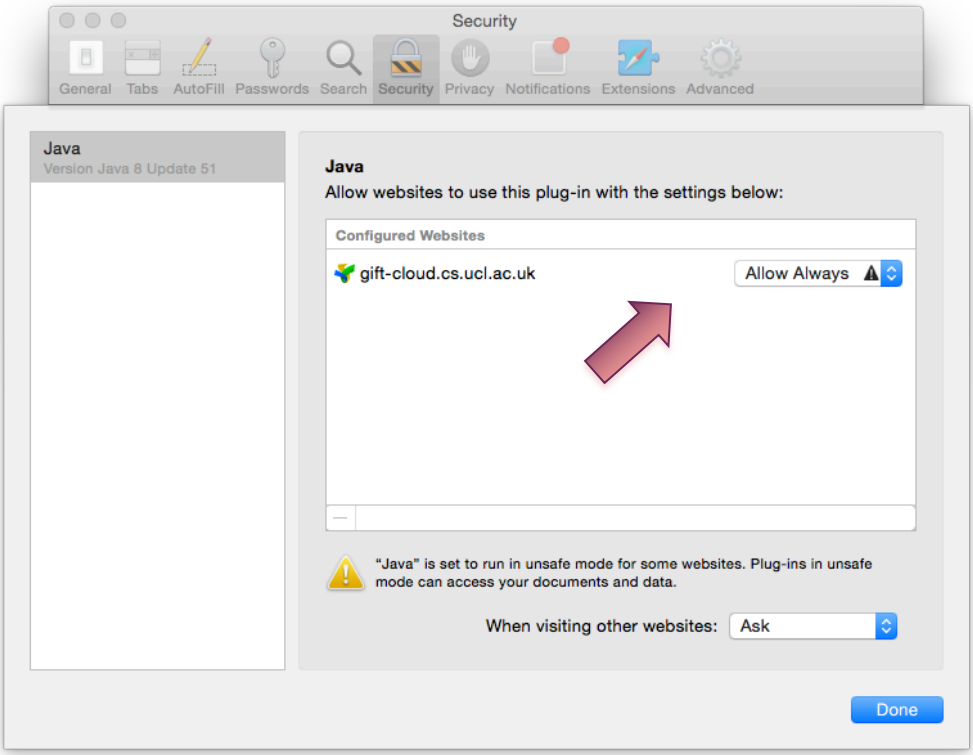


Configuring your browser – OSX Safari (Mac)

- Go to **Safari** > **Preferences** > **Security**
- Under **Internet Plugins**, enable **Allow Plug-ins** and then click **Website settings**



- Click on **Java**.
- Next to "gift-cloud.cs.ucl.ac.uk" change the drop-down to **Allow Always**:

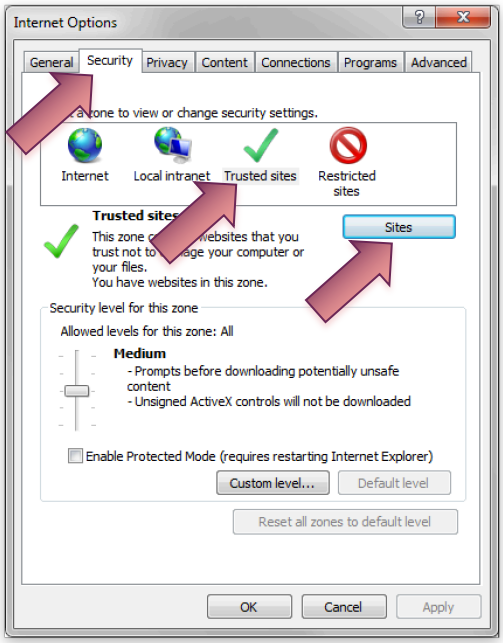


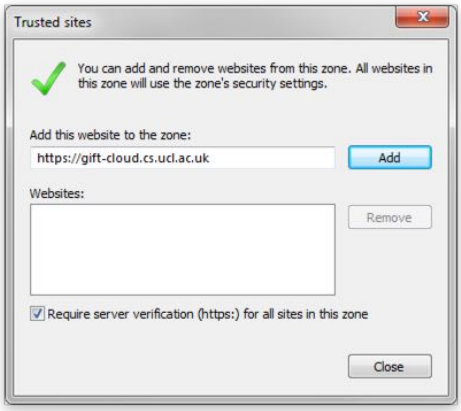
- Now change the same drop-down to **Run in Unsafe Mode** and click **Trust** when prompted *(NB due to a bug in Safari you have to change the drop-down to "Allow Always" before you can successfully change it to "Run in Unsafe Mode").*

Note: If you do not see gift-cloud.cs.ucl.ac.uk listed under Java, try restarting Safari and registering and logging into GIFT-Cloud as described below, and then come back and configure this screen later.

Configuring your browser – Internet Explorer 11 (Windows)

- Click the cog at the top right of the screen and select **Internet Options**
- Click the **Security** tab
- Select the **Trusted Sites** zone
- Click the **Sites** button
- Under **Add this website to the zone:** enter https://gift-cloud.cs.ucl.ac.uk
- Click **Add**

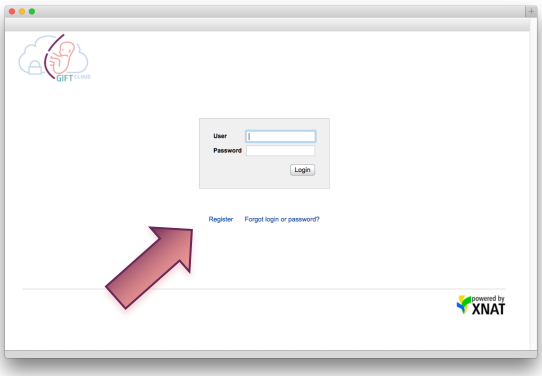




Creating a GIFT-Cloud account

You will need to create a personal account on GIFT-Cloud. To do this, go to the website, click ‘register’ and follow the instructions:

https://gift-cloud.cs.ucl.ac.uk



For security reasons, your account needs to be approved by the GIFT-Cloud administrators before it as activated. This may take a few days. You will also receive an email asking you to verify your email address.

Once your account is activated you can log into the website above and view and download data.

Data are contained within a number of different ‘projects’ on GIFT-Cloud. Users are granted access to projects as permitted by the data sharing agreements between the collaborating institutions.

You can use the same login details to access data using software that is compatible with XNAT or GIFT-Cloud. The same requirements for server access apply as with the website.

4 Browsing the GIFT-Cloud website

GIFT-Cloud uses a customised version of the standard XNAT web interface. Detailed user documentation can be found on the XNAT website:

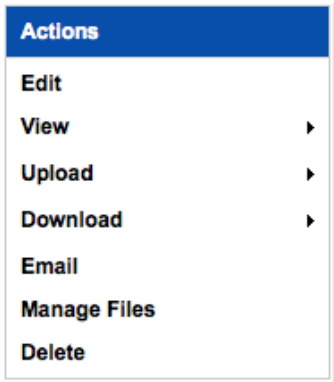
https://wiki.xnat.org/display/XNAT16/Home

Data is grouped into a number of projects, some of which contain clinical data, while others contain testing data. The projects to which you have access are listed on the Home tab. Click on a project to view its contents.

Within each project are the imaging subjects. When data is uploaded, it is anonymised and subjects are assigned an auto-generated name such as UCH-GIFTSURG-42. Click on a subject to view the data for that subject.

For each subject, images are grouped into ‘experiments’ (each corresponding to Dicom ‘studies’), and these are further grouped into ‘scans’ (each corresponding to a Dicom ‘series’). Within each scan (series) are the individual files. By clicking on a scan you can see a preview image and examine the Dicom headers for the files in that scan.

When examining scans, the action menu on the right side of the screen gives you options to download and examine files:



5 Downloading data

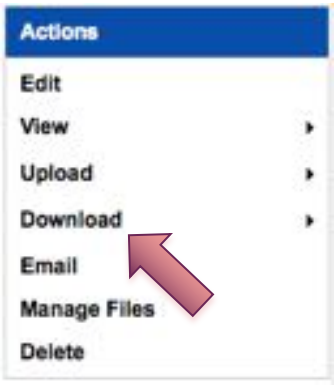
There are two main methods for downloading datasets from GIFT-Cloud

Download using XNAT-compatible software

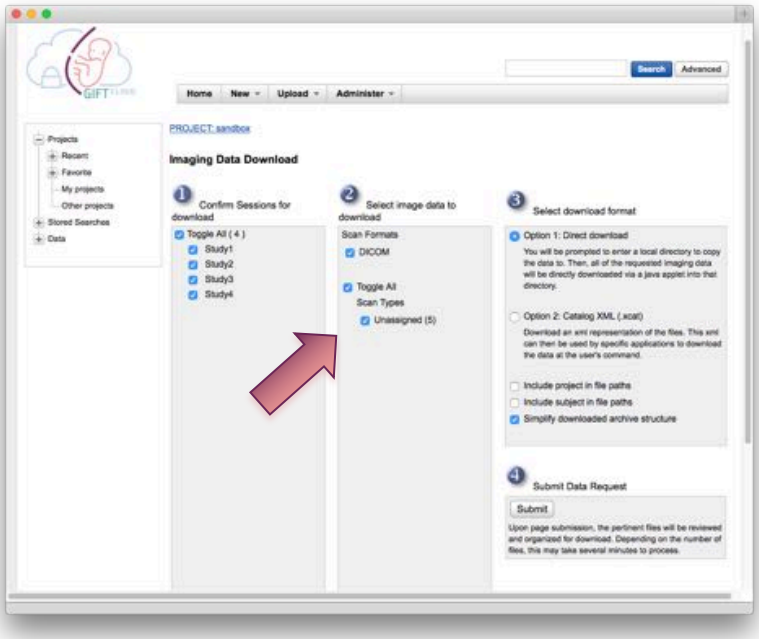
Programs that provide GIFT-Cloud or XNAT compatibility can be used to download data, for example GIFT-Proto and NiftyView (see application-specific documentation).

Download data from the GIFT-Cloud website

- Make sure you have configured your Java and web browser as described in section 3 above; this will enable the download applet to run correctly.
- When you browse the website and click on a project, experiment or scan, the you will see a **Download** or **Download Images** option appear in the right-hand menu. This is also available from search results via a drop-down menu.



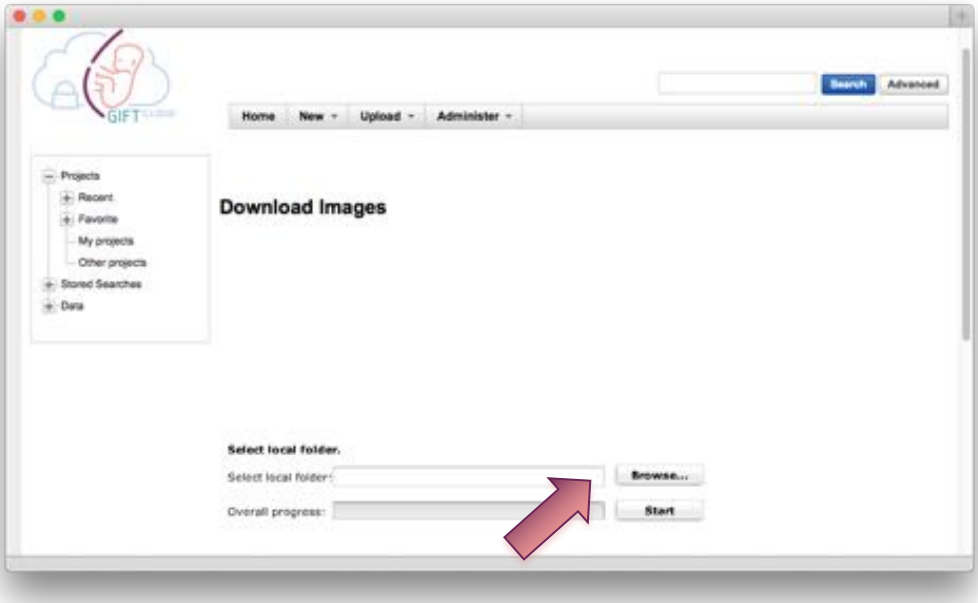
- Click **Download Images** (if available) or click **Download** and then select **Download Images**. This will open the **Imaging Data Download** or a similar screen:



- Ensure you tick all the sessions (studies) you wish to download in the first column. Make sure you tick **all** the scan formats in the second column, including **Unassigned** (see image above), unless you wish to exclude particular scan types.
- Click **Include project in file paths** and **Include subject in file paths** if you want the folder names created for the downloaded data folders to include the GIFT-Cloud project and subject names.
- Click **Submit**.

If you get the following security warning, click **I accept this risk** and click **Run**.

- When the Download Images page appears, click **Browse** to select a folder where the downloaded images will be saved.



Please note: when you browse for a path, if you do not see your local paths appearing in the dialog, it may be because you have not configured your Java and your browser as described in section 3 above.

- Click **Start** to start download.

More details about using the XNAT downloading interfaces are found in the XNAT documentation on the XNAT website:

https://wiki.xnat.org/display/XNAT16/XNAT+Data+Management#XNATDataManagement-HTTPDownload

6 Configuring GIFT-Cloud Uploader

You can add new data to GIFT-Cloud using GIFT-Cloud Uploader. There are two ways to use GIFT-Cloud Uploader:

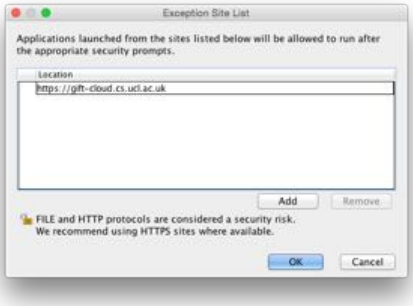
1. If you want to upload data from your computer, DVD, USB stick, local network etc. you can launch GIFT-Cloud Uploader whenever you want to upload data;
2. If you want to push data from a PACS system, medical scanner, OsiriX or other DICOM-compatible software, then you can configure GIFT-Cloud Uploader as a DICOM listening node that will receive and upload DICOM data. You may wish to install this on a server so that it is always running and available.

When running GIFT-Cloud Uploader for the first time you will need to configure your Java security settings and enter your GIFT-Cloud username and password to allow the Uploader to connect to the server.

Installing GIFT-Cloud Uploader

GIFT-Cloud Uploader is a cross-platform Java webstart application.

- Install Java if is not already installed.
- Open the **Java Control Panel**
  - *Mac OSX: System Preferences > Java*
  - *Windows XP: Start > Control Panel > Java*
  - *Windows 7: Start > Control Panel, then enter Java Control Panel in the **Control Panel Search***
  - *Windows 8: search for Java Control Panel*
- Under **Security**, edit the **Java Exception Site List** and add https://gift-cloud.cs.ucl.ac.uk



- In a web browser, go to the GIFT-Cloud website https://gift-cloud.cs.ucl.ac.uk and log in.

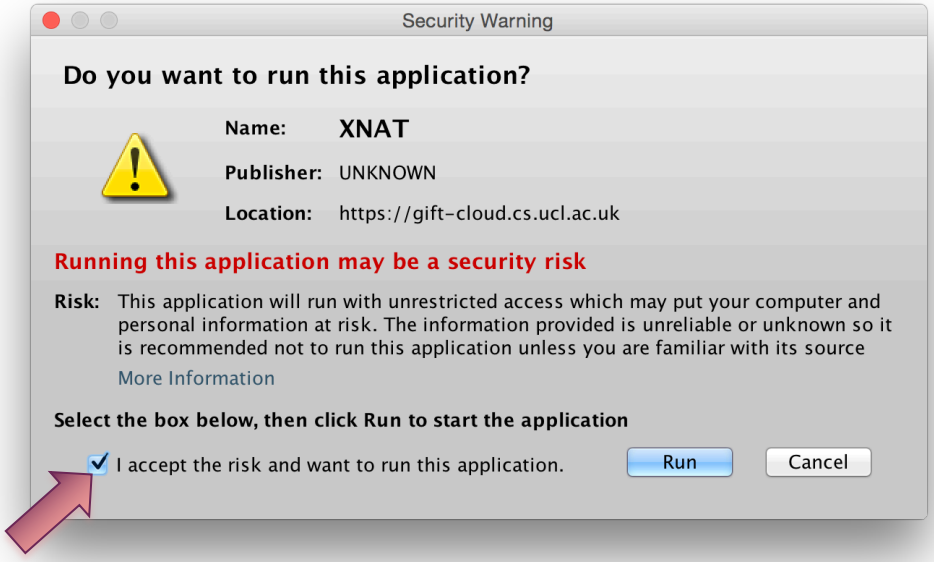
- Click “Upload” from the top bar of any webpage.
- If GIFT-Cloud Uploader does not download automatically, click the direct download link as instructed.
- If GIFT-Cloud Uploader does not start automatically, check your **Downloads** folder and launch the webstart.jnlp file there.

Running GIFT-Cloud Uploader

Once installed, you can run GIFT-Cloud Uploader by launching the webstart.jnlp file that was downloaded.

When you run the Uploader for the first time, or when it updates to a new version, you may see a warning similar to the following:

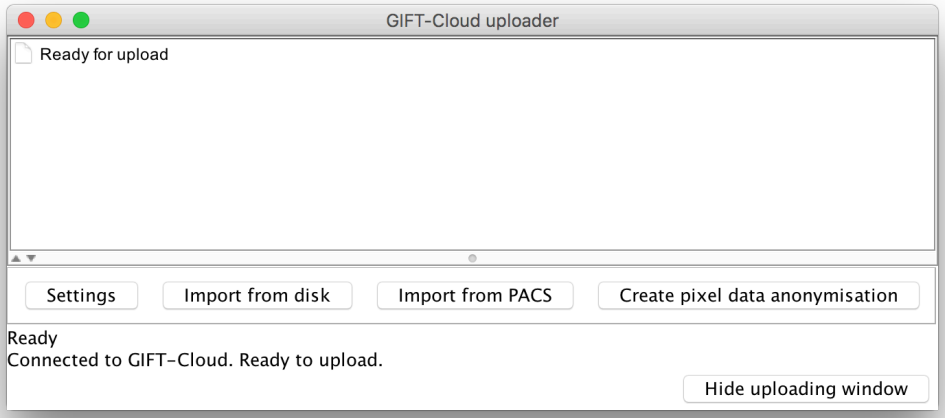
If you get the following security warning, click **I accept this risk** and click **Run**.



This is normal because GIFT-Cloud Uploader uses a self-signed certificate. Check **I accept the risk** and then click **Run**.

GIFT-Cloud Uploader will automatically update to a new version when available.

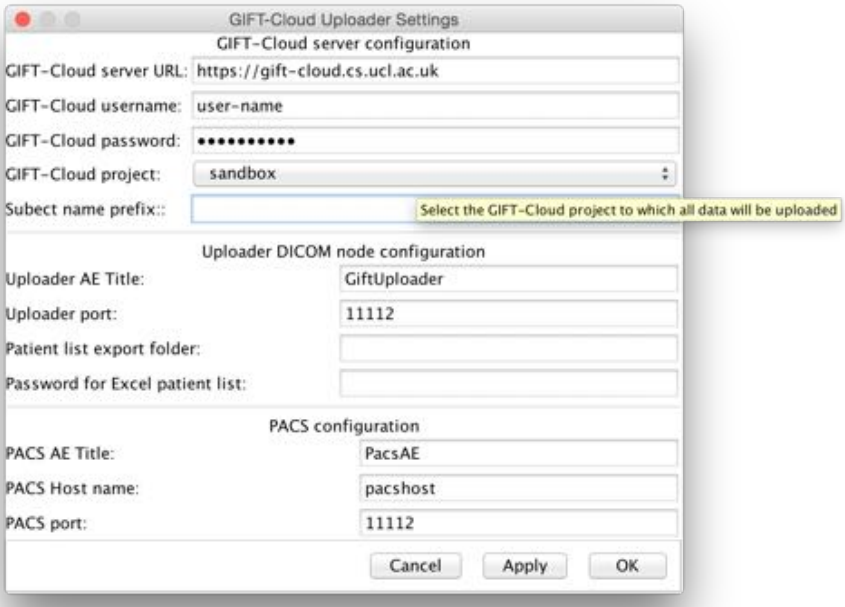
When the Uploader launches it will show the main window.



Before you upload any data you will need to configure the Uploader by modifying the settings – see the following section.

Configure the GIFT-Cloud Uploader

Click **Settings** to open the configuration dialog:



- Enter your GIFT-Cloud username and password.
- Click **Apply** – this will log into the server.
- Select a project from the GIFT-Cloud Project list. This is the project to which your data will be added.

  *NOTE: the project list will not appear until the login has been successful. If you enter the wrong username/password, correct it and click **Apply** again.*

- If you want the Uploader on your machine to act as a Dicom node, so that you can push data to it from another Dicom program or PACS, and that data will be automatically anonymised and uploaded, then set the **Uploader AE Title** and **Uploader port**.

  NOTE: please configure your machine's firewall to open the port you specify. The standard Dicom port is 11112. This port is not normally open by default. If you are pushing data from a different network, you will also need to ensure your network firewall allows this.

- If you want to be able to query/retrieve data from PACS or another Dicom-compatible program, set the values of the PACS server in the **PACS configuration** section.

Saving a patient list

You can configure GIFT-Cloud Uploader to automatically maintain an Excel patient list on your local machine. This list remains on the local network and does not get uploaded to the GIFT-Cloud server. The patient list contains the patient names, PACS IDs and GIFT-Cloud anonymisation identifiers for patients uploaded on this machine.

To automatically save a patient list as an Excel file, fill in a folder under **Patient list export folder**. To turn off patient list saving, leave this blank.

If you wish the Excel file to be password-protected, enter the password under **Password for Excel patient list**. To turn off the password, leave this blank.

Troubleshooting

If you have problems using GIFT-Cloud Uploader, please check the following:

- Your machine's IP address (or your site's IP netblock) must be added to the GIFT-Cloud whitelist by the GIFT-Cloud administrators (see above);
- Your firewall must be configured to allow https internet communication with the GIFT-Cloud server;
- Your firewall must be configured to allow communication on the port you have specified, if you are using the Dicom listening service;
- The local machine must have Java installed, minimum version 1.6 (later versions preferable);
- You must add the GIFT-Cloud server URL to the Java Exception Site List (see above);
- Your machine must be configured to permit the running of the Java webstart application;
- In some cases, restarting the GIFT-Cloud Uploader webstart application may fix server communication issues.

7 Uploading data

Before running GIFT-Cloud Uploader for the first time, please follow the installation and configuration instructions in section 6 above.

GIFT-Cloud Uploader supports the following methods for uploading:

- Select files and directories from your local machine, network drive, USB stick, DVD etc, then anonymise and upload the data
- Drag-and-drop files and directories from your local machine, network drive, USB stick, DVD etc, then anonymise and upload the data
- Act as a Dicom listening node, and automatically anonymise and upload data pushed to your machine
- Manually query multiple datasets from a PACS or other Dicom-compatible service, then retrieve, anonymise and upload the data.

Running GIFT-Cloud Uploader

Once installed, you can run GIFT-Cloud Uploader by launching the webstart.jnlp file that was previously downloaded (you can download it again if necessary).

You may get a certificate warning similar to that shown here:

This is normal because GIFT-Cloud uses a self-signed certificate. Click **Continue**.

GIFT-Cloud Uploader will automatically update to a new version when available.

When the Uploader launches it will show the main window.

Uploading data from your computer, a DVD, USB stick or the local file system

You can use one of the following methods:

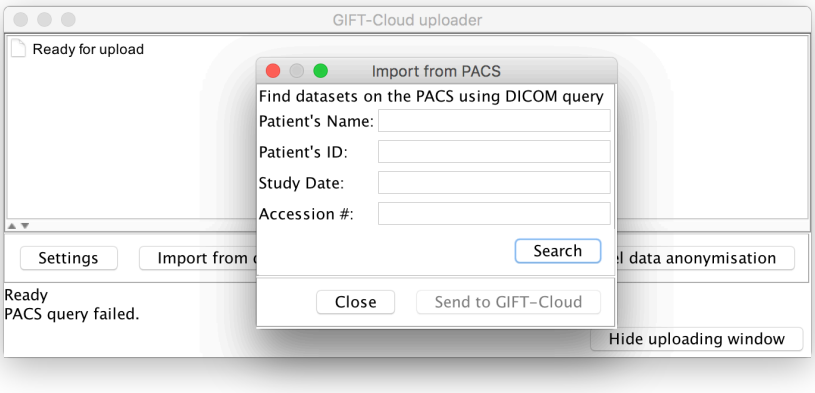
- Drag-and-drop files and folders onto the GIFT-Clod Uploader window;
- Click **Import from disk** and select one or more files and folders to upload.

If you select or drag-and-drop any folders, each folder will be searched recursively and all images in the folder and its subfolders will be uploaded. Files that cannot be uploaded will be ignored.

Uploading data from PACS, OsiriX or other systems using Query/Retrieve

You can connect to a DICOM query/retrieve system and retrieve and upload data. Firstly, configure the **PACS configuration** settings as described in section 6 above. If you are using OsiriX, you need to configure a Listener in the OsiriX preferences with AE title, port number and host matching the GIFT-Cloud Uploader PACS configuration settings.

Click the **Import from PACS** button. This will open the **Import from PACS** window:



Enter search terms and click **Search**. You can leave all the fields blank to show all data, but note that this could take a very long time on a large PACS database.

A tree browser will open showing datasets matching your search criteria. Select any patients, series and images you wish to import. You can select multiple images/series/patients using standard shortcuts such as CMD+click (Mac) or Ctrl+click (Windows)

Click **Send to GIFT-Cloud** to retrieve and upload the selected files.

Pushing data from PACS or OsiriX

To push DICOM data from a scanner, PACS, OsiriX or other DICOM compatible hardware or software, you need to set the **Uploader DICOM node configuration** settings as described in section 6 above.

Configure your DICOM device to add a destination matching these settings. For example, in OsiriX preferences, go to Locations and add a new Location node with the IP address of the computer running GIFT-Cloud Uploader, and enter the AE title and port of the **Uploader DICOM node configuration** specified in the GIFT-Cloud Uploader settings.

Once configured, you can send data to the GIFT-Cloud Uploader node for immediate anonymisation and upload. For example, in the OsiriX database, click on the data you wish to upload, click the **Send** button, and select the node you have configured.

- If you are running OsiriX and GIFT-Cloud Uploader on the same machine, you will need to assign them different port numbers.
- If you want to keep the node running permanently, you need to ensure the computer running the GIFT-Cloud Uploader DICOM node has a fixed IP address, otherwise the IP will change over time and you will have to modify the Location node settings each time.
- You must ensure your firewalls on the DICOM device and the computer running GIFT-Cloud Uploader are configured to permit data traffic through the ports you have specified.

8 Anonymisation of pixel data with burnt-in annotations

GIFT-Cloud Uploader can anonymise 2D ultrasound images and ultrasound loops that have patient data burnt into the pixel image data. Anonymisation is configured using templates, which are tailored to specific scanners and image resolutions. Once the required templates are defined, pixel data anonymisation is fully automated and requires no interaction with the user. A number of standard templates are provided with GIFT-Cloud Uploader, and you may also define your own templates.

Configuring pixel data anonymisation templates

Before creating your own templates, you may wish to check whether the existing templates are sufficient by uploading test data that represents the data you will be uploading. If the test upload reports a “no suitable template found” error then you will need to create a template.

To create a new template, launch the GIFT-Cloud Uploader and click the **Create pixel data anonymisation** button:

Select a Dicom file representing the type of image you wish to anonymise. A new window will open (this may take some time if your selected image is large or a video).

Use the left mouse to draw green rectangles. These regions will be blacked out in the anonymised image. If you want to remove a rectangle, left click it (it will become red) and click delete. You can use the right mouse button to adjust the window and level of the displayed image.

Click **Save template** to save the template and choose a filename. If you want to abandon your template, close the window without saving. To define another template, click **Select new image** and repeat the process.

Templates are defined based on the following DICOM header tags, which are derived from the test image you provide when creating the template:

- PhotometricInterpretation
- TransferSyntaxUID
- SopClassUID
- Modality
- Manufacturer
- ManufacturerModelName
- Rows
- Columns

If you upload an image which matches all of the parameters in the template, that template will be applied. For cine loops, the template is applied to each image in the loop.

Your custom templates are store in your home directory, under `GiftCloudUploader/RedactionTemplates`. If you want to remove a template you can simply delete it and restart the GIFT-Cloud Uploader.

9 Configuring the GIFT-Cloud server

This section is for GIFT-Cloud server administrators, or for users who wish to set up their own GIFT-Cloud server.

Installation

GIFT-Cloud uses a custom fork of the xnat_builder codebase. You will need to install XNAT according to the standard instructions, but use this codebase instead of the default XNAT codebase.

Firewall

The GIFT-Cloud server firewall must be configured with the netblock (IP address range) for any machines that wish to connect, including:

- any machines that will be used to browse and download data;
- any machines that will be used to upload data using the web-based uploader;
- any machines running the uploader service.

Communication with the GIFT-Cloud server uses HTTPS. If non-standard ports are required, these may require special configuration of the GIFT-Cloud server and UCL firewalls.

10 Confidentiality of clinical data

XNAT is used to securely host clinical research data at many institutions worldwide [3]. In addition to GIFT-Cloud, UCL has a well-established XNAT installation on the CMIC-XNAT server [4] which is used by a number of research projects involving clinical data [5][6].

GIFT-Cloud at UCL is based on the established security model used by the CMIC-XNAT server. This includes the following security features:

a. The server is accessible only through the well-established HTTPS protocol [7], which makes it mandatory that the data traffic between the client and the server be encrypted.
b. A firewall on the server blocks access except from trusted clients (the UCL and KUL domains, and research partners outside UCL), via IP whitelisting.
c. XNAT implements a security model that allows user access control on a per project basis. This allows us to restrict access for certain data to specific groups of users, if required [8].

The confidentiality of personal identifiable data (PID) is protected in GIFT-Cloud through pseudonymisation. Pseudonymisation in general comprises:

a. Deleting a large portion of PID (including pixel data that could potentially be used for identifying a patient), which is not relevant to the research objectives,
b. Replacing relevant PID with uniquely generated identifiers (e.g. enumerated values, hash codes), allowing for later re-identification by authorised personnel (e.g. the radiologist who keeps the map of real identifiers versus generated identifiers).

We aim to provide an intuitive mechanism for fully automated, on-site pseudonymisation (i.e. such that no PID is transmitted over the network). Existing well-established policies (see [9][10][11][12]) and laws (UK, EU, USA where applicable) are the basis of the pseudonymisation procedure.

Data upload and download procedures

The following figures illustrate how data confidentiality is ensured by the procedures.

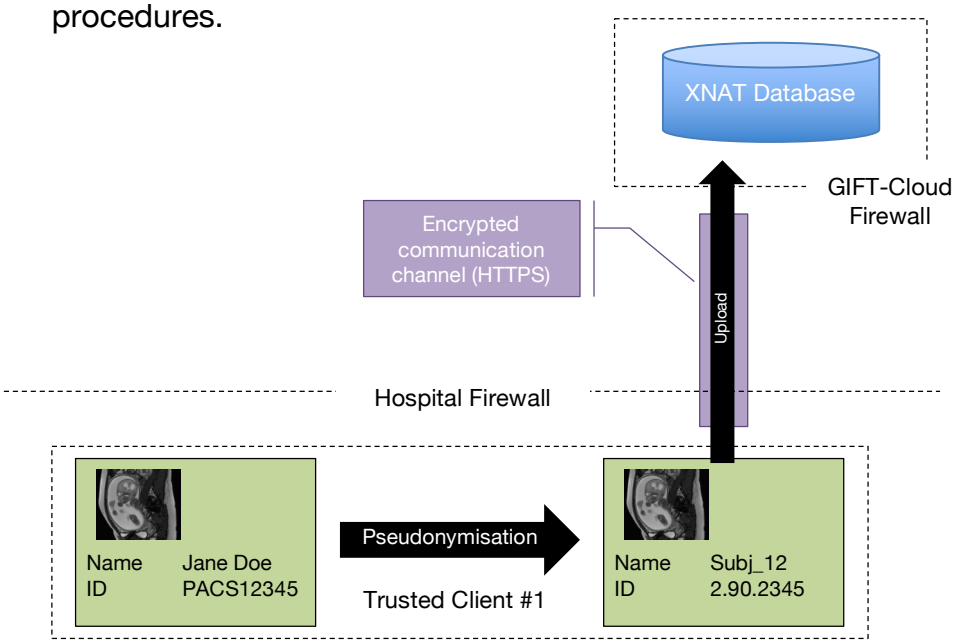


Figure 1: Data upload. Every PID is anonymised **on the client, prior to upload**. This ensures that the server does not store any sensitive information that could lead to patient identification.

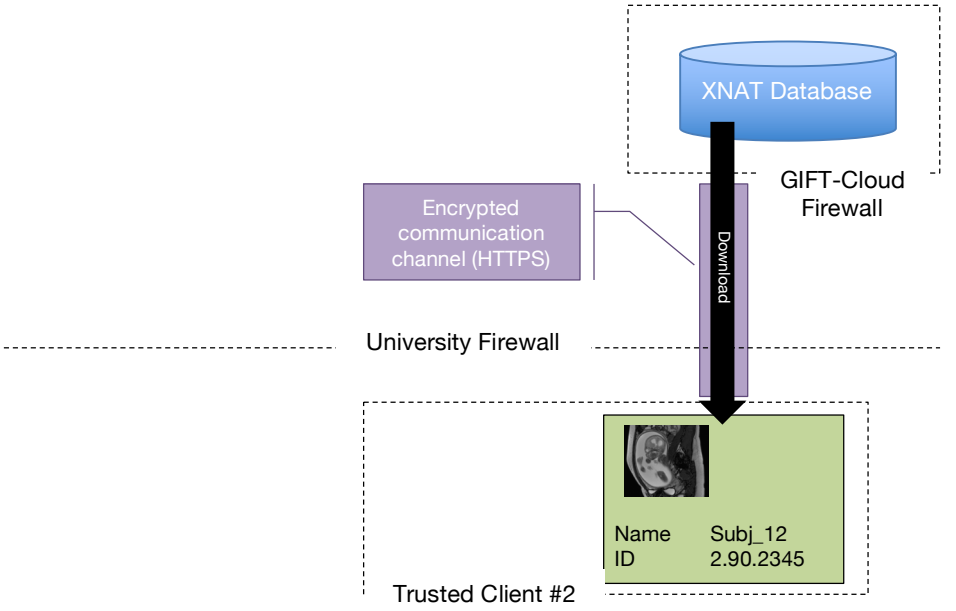


Figure 2: Data downloaded by researcher in a collaborating academic institution. The researcher **has no access to PID**, but rather only to **pseudonymised identifiers.**

11 References

[1] Translational Imaging Group http://cmictig.cs.ucl.ac.uk
[2] XNAT Open Source Imaging Informatics Platform, Neuroinformatics Research Group at Washington University, USA http://xnat.org
[3] XNAT implementations around the world, http://xnat.org/about/xnat-implementations.php
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