Move Service Class User (C-MOVE SCU)

The C-MOVE SCU protocol is used to retrieve images from another DICOM node and is used when the Query tool is selected from the toolbar. A DICOM node describes any networked DICOM software or hardware, which is used to manage, process or transfer DICOM images. This is essentially a workstation or PACS server. Each DICOM node is uniquely identified by the TCP/IP address of the computer e.g. 174.14.5.18 as well as the TCP/IP Port e.g. 4686 and its Application Entity (AE) title e.g. Horos.

The C-MOVE SCU protocol requires that the server knows both the IP address, or DNS address, and the AE Title of the client, i.e the Horos application. If this information and the appropriate permissions have not been shared and agreed with the server then the association will fail and the image retrieve request will not be fulfilled.

However an alternative is to use the C-GET protocol. Provided the user (client) has selected the C-GET option for the requested DICOM node and that DICOM node supports the C-GET SCP protocol, this can be used instead. It should be noted that to use the C-GET protocol the distant node (server), must be running the current version of Horos.

In the same way as the C-FIND SCP, queries are accepted at the study, series or image level, but not at the patient level.

The C-MOVE SCU protocol uses the study, series or image unique identifiers (StudyInstance UID, SeriesInstranceUID and SOIPInstanceUID) for each *Query* sent.

It is possible for the images which are retrieved to be sent to an alternative DICOM node, as opposed to your current workstation. This is described in more detail in the Query and Retrieve section, earlier in this chapter.

If the Networks logs function has been activated, see Chapter 2, each C-MOVE SCP is logged within the Network Log file.

The same transfer syntaxes, or encoding rules, are used as for the C-FIND SCP, as described above.

In contrast to the C-MOVE SCP, an error message IS generated if the C-MOVE SCU fails.

Get Service Class Provider (C-GET SCP)

The C-GET protocol is very similar to the C-MOVE, however it has the advantage of avoiding problems relating to matching the AE title of your Horos application, intrinsic to C-MOVE. Upon launch of Horos, if the DICOM Listener has been activated, the C-GET SCP launches. See Chapter 2 for further details on activating and other options for the DICOM Listener.

Once the C-GET SCP is launched and an association is started, in a similar way to the C-STORE SCP, a separate 'forked' process commences. The outcome of this is that the C-GET SCP thread will continue to run in the background irrespective of other functions being undertaken within Horos and cannot be blocked by other actions of the Horos user.

Should the C-GET SCP protocol crash, due to corrupted data for example, only this protocol will be affected and the Horos application will continue to function. No error message will be displayed. It is the corresponding C-GET Service Class User (SCU) which is responsible for generating the error message.

In the same way as the C-FIND SCP, queries are accepted at the study, series or image level, but not at the patient level.

If the Networks logs function has been activated, see Chapter 2, each C-GET SCP is logged within the Network Log file.

The same transfer syntaxes, or encoding rules, are used as for the C-FIND SCP, described above.

Get Service Class User (C-GET SCU)

The C-GET SCU protocol is used to retrieve images from another DICOM node and is used when the *Query* tool is selected from the toolbar. A DICOM node describes any networked DICOM software or hardware, which is used to manage, process or transfer DICOM images. This is essentially a workstation or PACS server. Each DICOM node is uniquely identified by the TCP/IP address of the computer e.g. 174.14.5.18 as well as the TCP/IP Port e.g. 4686 and its Application Entity (AE) title e.g. Horos.

The C-GET SCU protocol will only be used if:
- The user (client) has selected the C-GET option for the requested DICOM node
- The DICOM node supports the C-GET SCP protocol

The C-GET SCU protocol therefore has the advantage, when compared to the C-MOVE SCU protocol, that the distant node (server) does not require the AE title or IP address of your Horos application. However the distant node (server) must be running the current version of Horos.

More information on selecting the C-GET option can be found in Chapter 2.

In the same way as the C-FIND SCP, queries are accepted at the study, series or image level, but not at the patient level.

Similarly to the C_MOVE SCU, The C-GET SCU protocol uses the study, series or image unique identifiers (StudyInstance UID, SeriesInstranceUID and SOIPInstanceUID) for each query sent.

If the Networks logs function has been activated, see Chapter 2, each C-GET SCP is logged within the Network Log file.

Print Service Class User (C-PRINT SCU)

Horos can be configured to print through the *Print* option in *Preferences* and DICOM printing is supported through the C-PRINT SCU.

Once the C-PRINT SCU is launched and an association is started, in a similar way too the C-STORE SCP, a separate 'forked' process commences. The outcome of this is that the C-PRINT SCP thread will continue to run in the background irrespective of other functions being undertaken within Horos and cannot be blocked by other actions of the Horos user.

Should the C-PRINT SCU protocol crash, due to corrupted data for example, only this protocol will be affected and the Horos application will continue to function. No error message will be displayed.

Similar to the C-FIND SCP, events are not logged.

Auto-Query & Retrieve

Auto-Query and Retrieve allows you to set up rules to automatically download studies using the same search criteria, from other DICOM nodes. This saves you having to repeatedly open, enter and submit searches through the Query window. For example, you may wish to set up Horos to automatically download all MR images produced throughout the day.

A DICOM node describes any networked DICOM software or hardware, which is used to manage, process or transfer DICOM images. This is essentially a workstation or PACS server. Each DICOM node is uniquely identified by the TCP/IP address of the computer e.g. 174.14.5.18 as well as the TCP/IP Port e.g. 4686 and its Application Entity (AE) title e.g. Horos.

To do this, first select *Auto Query/Retrieve Window* from the *Network* contextual menu (fig 9.10).
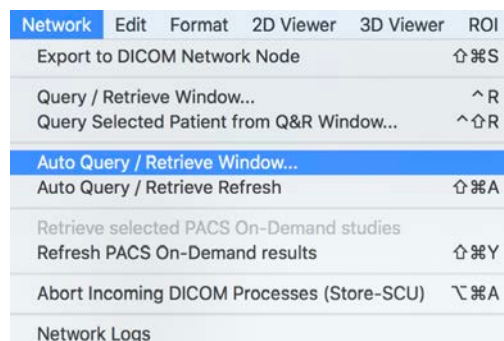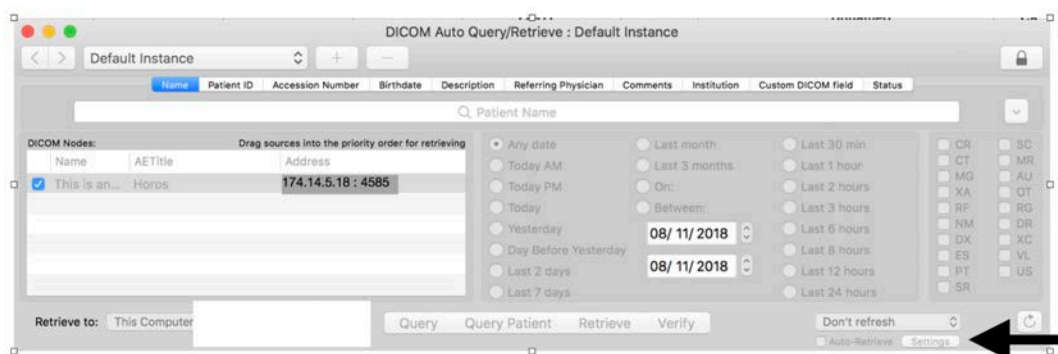
Figure 9.10 The *Network* contextual menu showing the Auto Query/Retrieve Window option

Within the *Auto-Query/Retrieve* dialogue box, enter your search criteria and select the required DICOM nodes, as described earlier on this chapter (Fig 9.11). To 'create' or delete instances, select the '+' or '-' buttons respectively from the Auto-Query window.

To view or modify a running instance, use the toggle button on the top toolbar on the Auto-Query window.

You can 'Lock' an instance by clicking on the padlock button in the top right hand corner of the window. This prohibits any modifications to the running instances.

NOTE: If a study has previously been downloaded into Horos, with the same number or more images, it will not be retrieved.

Figure 9.11 The *Auto Query/Retrieve* dialogue box, with the *Auto-Retrieve* option highlighted

It is possible to set up multiple rules, known as instances. For example you could have:

- An instance querying MR images from a specific DICOM node, acquired during the last hour

- Another instance querying all images acquired from another DICOM node over the last 24 hours

To automatically re-activate the last Auto-Query & retrieve upon launch of Horos open the Horos contextual menu and select *Preferences.* From the *Preferences* window select the *Locations* icon. Here you can select the option to *'Restart DICOM Auto-Query & Retrieve* settings, at launch' (Fig 9.12). See Chapter 2 for more details.
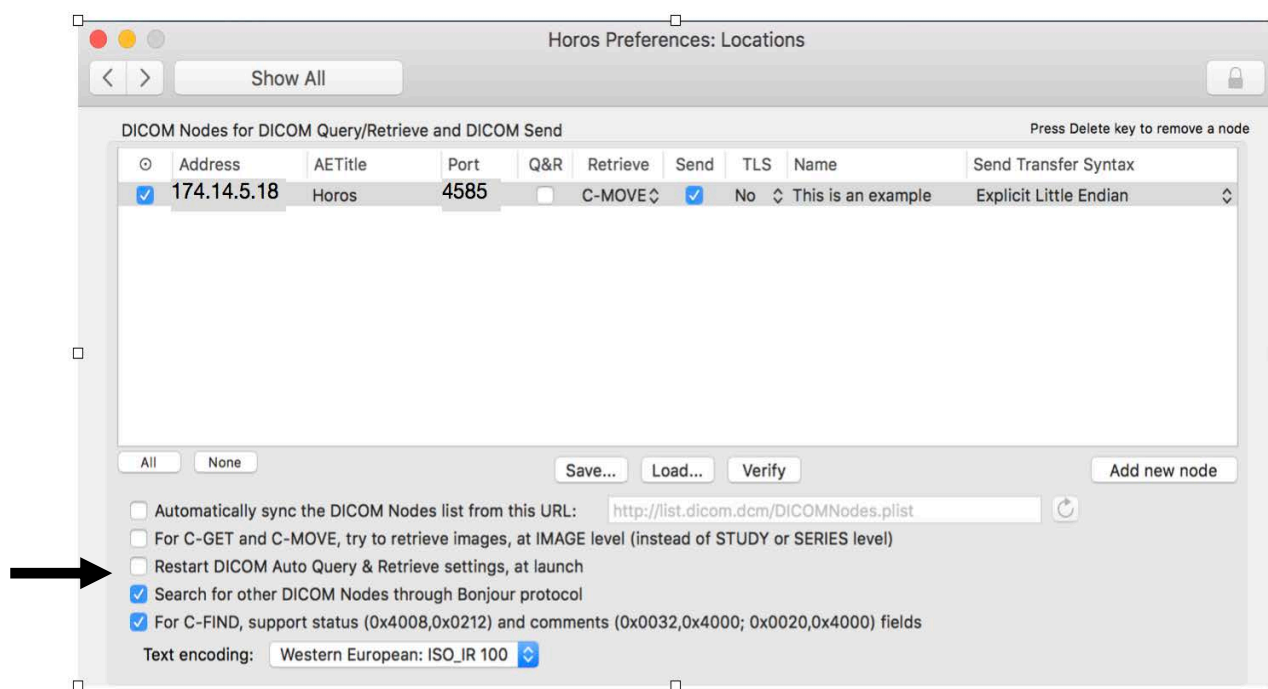
Figure 9.12 The Horos Preferences: Locations window, with the 'Restart DICOM Auto-Query & Retrieve settings, at launch' highlighted

Auto-routing

This is used to automatically forward images you have received or data you have produced, to other DICOM nodes. More details on this can be found in Chapter 4.

A DICOM node describes any networked DICOM software or hardware, which is used to manage, process or transfer DICOM images. This is essentially a workstation or PACS server. Each DICOM node is uniquely identified by the TCP/IP address of the computer e.g. 174.14.5.18 as well as the TCP/IP Port e.g. 4686 and its Application Entity (AE) title e.g. Horos.

Each rule you set up will be tested every 30 seconds. If there are images which match the rule, they will automatically be sent to your preferred DICOM node(s) using the DICOM C-STORE SCU protocol. The thread will appear in the *Activity* section of the left-hand side panel of the database window. See Chapter 4 for more details on the left hand side panel.

Rules will automatically be re-tried every 30 seconds if they fail, due to a network issue or the destination node is turned off. The number of re-tries is defined when setting the rule.

Setting up Horos as a PACS (Picture Archiving and Storage)

It is possible for Horos to be used as a PACS server, meaning that any workstation running DICOM compatible software can search and download studies stored in Horos. These workstations, local or distant, as well as the Horos workstation used as a PACS, are known as DICOM nodes.

A DICOM node describes any networked DICOM software or hardware, which is used to manage, process or transfer DICOM images. This is essentially a workstation or PACS server. Each DICOM node is uniquely identified by the TCP/IP address of the computer e.g. 174.14.5.18 as well as the TCP/IP Port e.g. 4686 and its Application Entity (AE) title e.g. Horos.

The number off images stored can be millions and is only really limited by the storage capacity of the server or workstation running Horos. RAID disks, for example, can be useful in maximizing storage capacity.

Multiple connections can be processed by Horos simultaneously, allowing multiple users to search, upload or download data to Horos without slowdowns.

To allow Horos to run efficiently as a server, it is recommended that you turn on *Server mode* within the *Listener Preferences* (Fig 9.13). In this mode, error messages are not displayed on screen. This allows Horos to continue working, even if an error occurs during communications with another DICOM node. Otherwise, should an error occur, Horos can be blocked from working until the user presses *OK* on the dialogue box which appears.
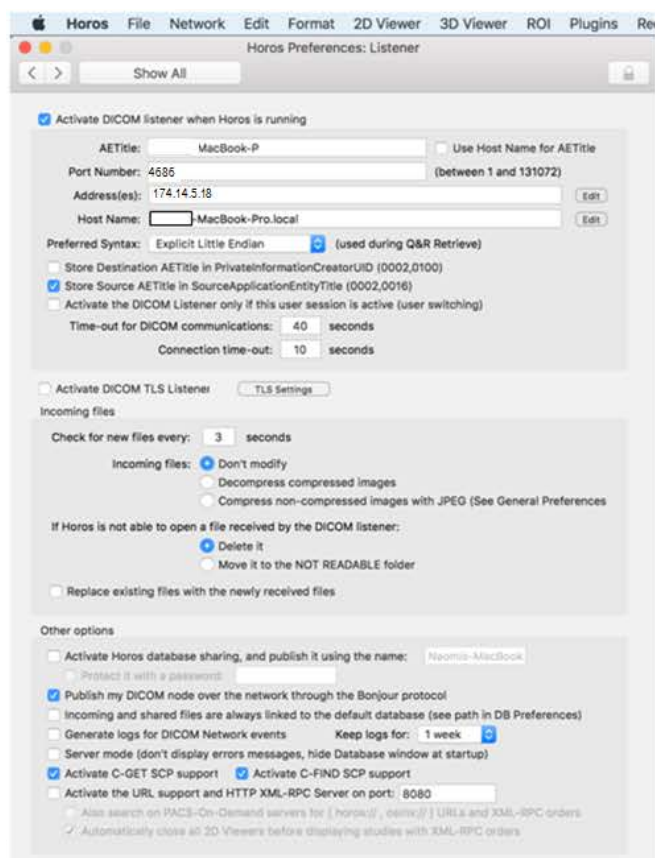
Figure 9.13 Listener Preferences with Server mode highlighted

Horos supports all the DICOM protocols required for it to be used as a PACS server (DICOM C-FIND, SCP, DICOM C-MOVE SCP, DICOM C-GET SCP and WADO). More information on these protocols can be found earlier in this chapter.

More information on setting preferences to run Horos as a PACS server can be found in Chapter 2.

The section on *Building a JPEG 2000 network* later in this chapter also provides more information on how to build and integrate Horos as an efficient PACS.

Synchronize and Archive

Horos can be used solely as a DICOM viewer for viewing images produced on different imaging modalities. Horos also generates data off its own such as Regions of Interest (ROIs) on images, comments, statuses, reports and secondary captures (SC). If using Horos in a PACS environment, or when multiple Horos workstations are used, automatically synchronization this data on all the Horos workstations, then archiving them on a PACS server, can be extremely useful. The Horos database then stores the data in DICOM SR format.

An auto-routing rule is required to automatically transfer DICOM SR files, once they have been generated. To do this first go to the *Horos* contextual menu and select *Preferences* (Fig 9.14a). This will bring up the *Preferences* menu window, here you select *Routing* (Fig 9.14b).
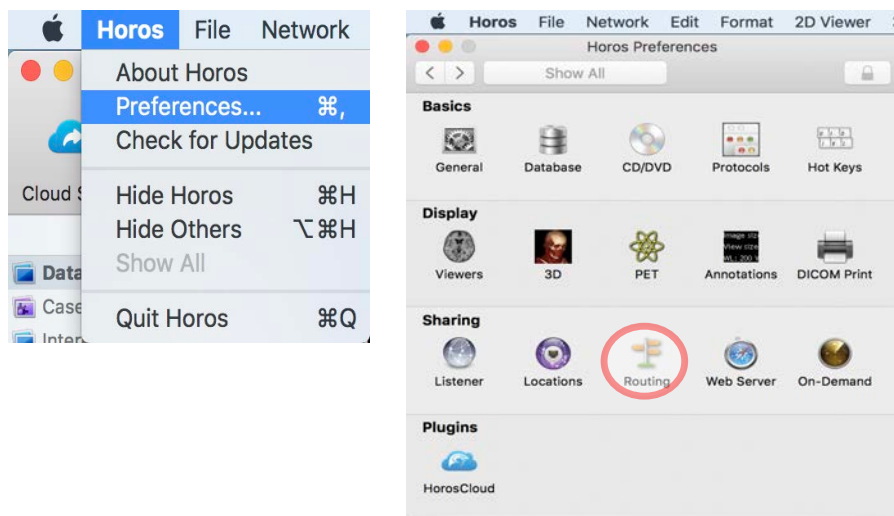

Figure 9.14 The *Horos* contextual menu with *Preferences* highlighted (a), and the Routing option in the *Preferences* window (b)

A dialogue box will appear. To create a new Auto-route, click on the option to do this in the bottom right hand corner of the window (Fig 9.15).
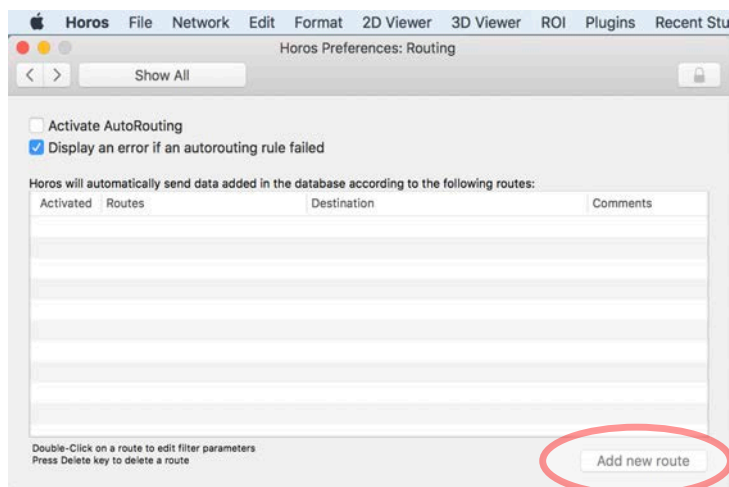

Figure 9.15 The Routing dialogue box with *Add new route* highlighted

In the next dialogue box which appears you will be able to set-up the Auto-route to allow you to automatically Synchronize and Archive files (Fig 9.16). You will need to set-up a new Auto-route rule for each workstation you wish to synchronize.

There are a number options you will need to select to set-up the new rule:

- Give the new route a name
- Select the destination of the data e.g. a PACS or another Horos workstation
- Select Data Generated (Status, Comments' Key Images, Secondary Captures, …)
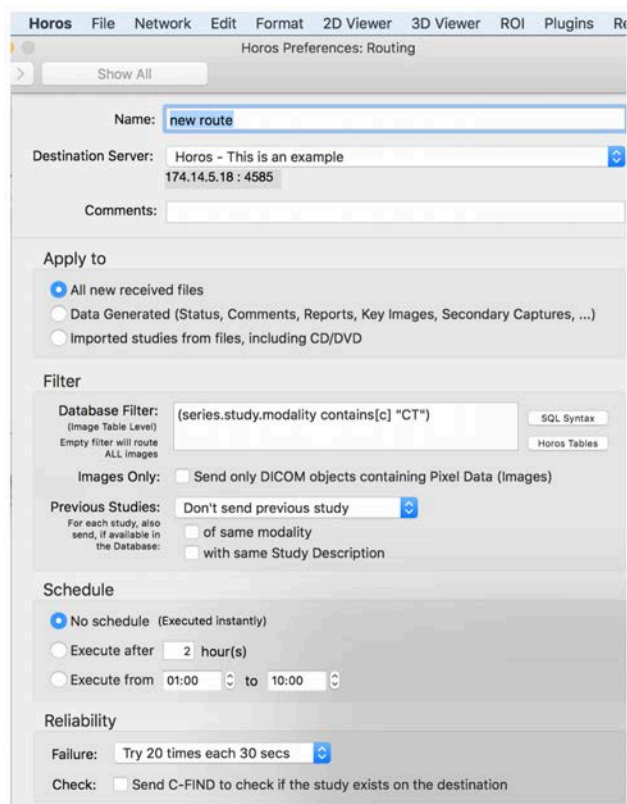

Fig 9.16 The *Routing* dialogue window

As the data is stored in DICOM SR format, the DICOM objects can be transferred and stored by any DICOM compatible software. This includes DICOM viewers and PACS, which are compatible with DICOM SR. They cannot however display and use these files. Only Horos can read, understand and manipulate these DICOM SR files.

It is possible to manually transfer data where this is more appropriate, for example if your Horos workstation is not connected to the network.

To do this select the desired studies from the database window. Right click on the study/studies and select *Apply this Auto-routing rule to selection* (Fig 9.17). You will be given the option to chose the rule you previously defined within *Routing Preferences,* or to set-up a new rule. The data is then transferred to the corresponding destination.
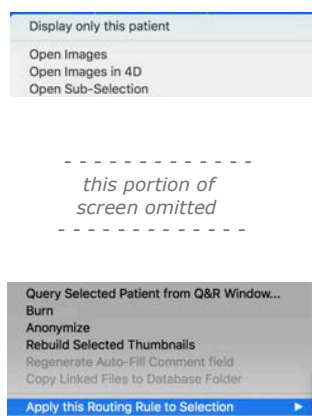
Figure 9.17 The Database Window contextual menu.
Apply this Auto-routing rule to selection is found as the
final option of the contextual menu.

WADO

The WADO protocol, supported by Horos, is used for retrieving DICOM files through standard HTTP protocols, and is defined in the DICOM standard. This has the consequence of reducing the complexity of DICOM transfers and provides the option of allowing the images to be displayed using any type of software, if they are sent as standard JPEGs.

The advantages of using WADO are:

- Multiple channels can be utilised when transferring studies utilizing full network bandwidth. This is useful on slow connections, e.g. a DSL (digital subscriber line)

- No fixed IP address is required, which is unlike Virtual Private Network (VPN) connections where this is often the case. This is similar to the DICOM C-GET SCU protocol

Horos can also act as a server using the WADO protocol and can retrieve images from compatible software e.g. Horos or dcm4chee. The Horos Web Server activates the WADO server protocol. The WADO client protocol can be activated using the DICOM Node list. See Chapter 2 for more information.

Database Sharing

Database sharing, supported by Horos using the Bonjour protocol to allow you to discover other workstations, allows the sharing of your database content with different Horos workstations on a network. Access can be password protected or unrestricted.