

User Manual

Multi-Server Distributed Computing Platform

T-arenal

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Chapter 1

System Description

The Platform of Distributed Tasks, T-arenal, is an informatics application that offers a computing alternative and that group in only set several workstations to perform the processing of computationally hard tasks. The T-arenal system was created with the purpose of utilizing the maximum amount of computational resources under its controls in a local network, without limitations in the size of the system. To accomplish this, the peer-to-peer and client-server architecture were combined within one model. The peer-to-peer model was implemented among the servers of the system. The system is divided in two main parts: back-end and front-end. The front-end is the means of accessing functionalities on the system by users, while the back-end is the responsible to perform all requests made via front-end. The Java RMI communications technology is used for message passing among the modules of T-arenal, as well as Java Sockets and Apache FTP to exchange large data files.

The back-end of T-arenal is based on a multi-server model organized as a tree of three levels (see Figure 1.1). It is divided into three software components: *root server*, *request server* and *client*. On each server a local relational database based on Apache Derby project is employed with the goal to persist those instances responsible of system's operation. The *root server* constitutes the face from the back-end to the front-end and thus, it is the accountable of handling or assigning to one of the *request servers* the demands performed via front-end. Also, it controls the access and management of all system objects, as well as it tracks of the system events by means of a logging scheme. In addition, it is the responsible to carry out the allocation of an incoming calculation task to the most suitable *request server* for their processing according to a scheduling algorithm. The scheduling algorithm also decides when a *request server* must

collaborate with other to perform a computation task. Moreover, the *root server* has a mechanism to allocate the clients of the system to the corresponding *request servers* according to user-defined allocating rules.

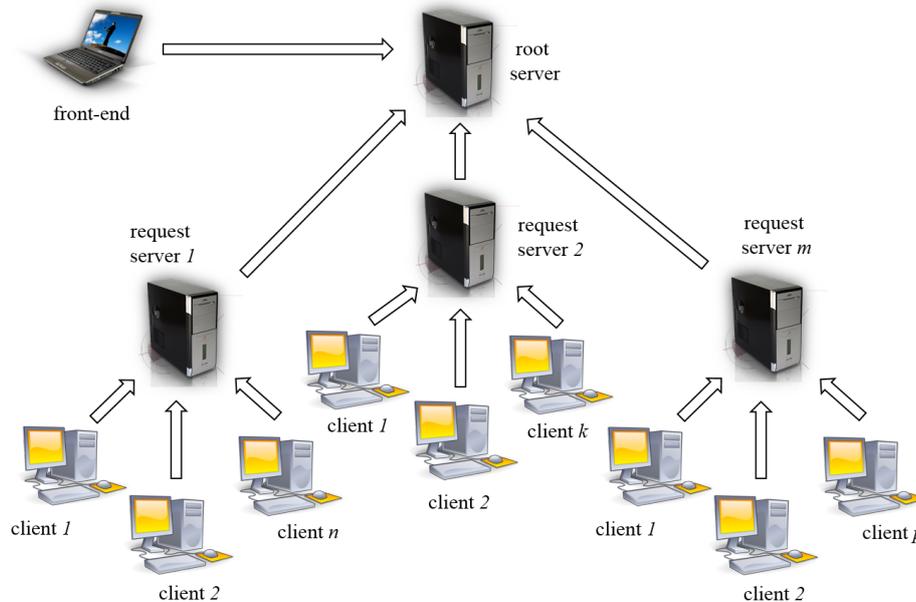


Figure 1.1: General architecture of the Platform of Distributed Tasks.

On the other hand, the *request server* is the module responsible for breaking down the assigned task(s) [task data and algorithm to process it] into smaller sub-tasks (also called work units) according to a user-defined algorithm, and collecting the results obtained from processing performed by the *clients* in order to construct the final solution of the original task(s). Another functionality of a *request server* is to control the work units (sub-tasks) created and that still do not have been processed during a computation. The amount of *request servers* to use in the system is according to the logical structure in which the workstations are grouped, *e.g.* per sub-network, laboratory, department and so on. There again, new *request servers* can be dynamically (in execution time) added or removed without affecting the distributed system. It is important to remark that the *request servers* can handle one or several tasks of different priorities at the same time. This number of tasks can be user-defined (by default is equal to 1) and its minimum value is 0. This last value indicates that all resources belonging to a *request server* will be used to help in the accomplishment of a task placed in another *request server*. This collaboration schema is

also employed when the number of tasks in the system is less than the number of available *request servers*.

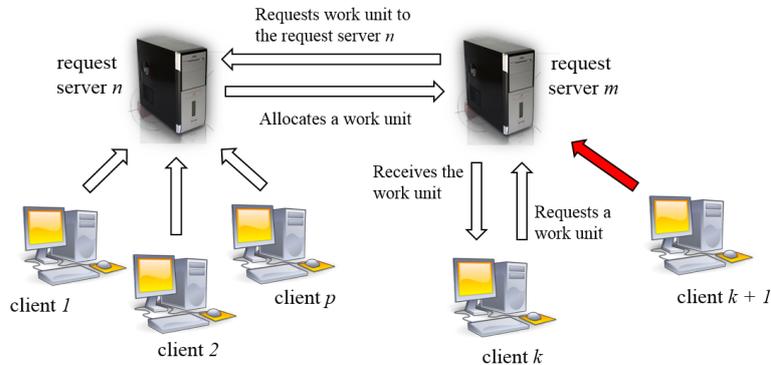


Figure 1.2: The *request server m* collaborates in the calculation task performed by the *request server n*.

Finally, the *client* module is the accountable to perform the processing of the work units assigned from the corresponding *request server*. To this end, the *client* frequently requests a work unit, performs its processing, returns the result to the *request server* and once again requests another work unit. If at any time the *client* does not receives a work unit to process, it will go into a “sleep mode” during a time before to perform the operations previously described. Moreover, if a work unit is assigned then the *client* will not contact again with the corresponding *request server* until the sub-task is processed or an exception occurs. All the communications between a *request server* and their *clients* are initiated by these latter.

Chapter 2

System Installation

2.1 Software Requirements

☞ Java Runtime Environment (JRE) version 1.7

2.2 Steps to install the *Root Server* module

2.2.1 GNU / Linux - Unix

1. Create the `/usr/local/tarenal` directory.
2. Copy and unzip the `Linux_tarenalrootserver.rar` file into `/usr/local/tarenal` directory.
3. For changing the RAM amount to use by the root server, you must open with a text editor the `/usr/local/tarenal/t-arenalRootServer.sh` file and in the line 67 to change the values of the next arguments:

☞ **-Xms:** in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be `-Xms64m`.

☞ **-Xmx:** in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be `-Xmx512m`.

4. Grant execution privilege to the `/usr/local/tarenal/t-arenalRootServer.sh` file.

5. With a text editor to open the `/usr/local/tarenal/rootserver/properties/client_distribution` file to edit the allocating rules to the *request servers* of the *clients* of the system (see Section 2.2.3).
6. With a text editor to open `/usr/local/tarenal/rootserver/properties/server.properties` file and you perform the corresponding changes (see Section 2.2.4).
7. With a text editor to open `/usr/local/tarenal/rootserver/security.pol` file and to specify the permissions with which the *root server* will be executed (optional).
8. Execute the next command line: `ln -s -f /usr/local/tarenal/t-arenalRootServer.sh/etc/init.d/t-arenalRootServer`.
9. Execute the next command line: `update-rc.d t-arenalRootServer defaults`.
10. Execute the next command line: `/etc/init.d/t-arenalRootServer start`.
11. For verifying if the *root server* was successfully started, in the `/usr/local/tarenal/rootserver/logs/system0.log` file must be appear “**Completed Root Server Initialization**”.

2.2.2 Windows NT / 2000 / XP

1. Star session as system administrator.
2. Create the `C:\Program Files\tarenal` directory.
3. Copy and unzip the `Windows_tarenalrootserver.rar` file into `C:\Program Files\tarenal` directory.
4. With a text editor to open the `C:\Program Files\tarenal\rootserver\properties\client_distribution` file to edit the allocating rules to the *request servers* of the *clients* of the system (see Section 2.2.3).
5. With a text editor to open the `C:\Program Files\tarenal\rootserver\properties\server.properties` file and to perform the corresponding changes (see Section 2.2.4).
6. With a text editor to open the `C:\Program Files\tarenal\rootserver\security.pol` file and to specify the permissions with which the *root server* will be executed (optional).

7. With a text editor to open the **C:\Program Files\tarenal\updateReg.txt** file and perform the next modifications:
 - 7.1. **Application:** in this property must be replaced the string *JAVA_PATH* by the path where the Java Runtime Enviroment is installed. For instance: *C:\Program Files\Java\jre6\bin*.
 - 7.2. **AppParameters:**
 - 7.2.1. Replace the string *SERVER_PATH* by the path where the root server is installed, that in this case is **C:\Program Files\tarenal\rootserver**.
 - 7.2.2. Modify the next arguments to custom the RAM use:
 - ☞ **-Xms:** in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be *-Xms64m*.
 - ☞ **-Xmx:** in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be *-Xms512m*.
 - 7.3. **AppDirectory:** in this property must be replaced the string *SERVER_PATH* by the path where the root server is installed, that in this case is **C:\Program Files\tarenal\rootserver**.
8. To perform double click on **C:\Program Files\tarenal\setup.bat** file.
9. For verifying if the *root server* was successfully started, in the **/usr/local/tarenal/rootserver/logs/system0.log** file must be appear “**Completed Root Server Initialization**”.

2.2.3 Edit the the *client_distribution* file of the *root server*

In this file must be specified the *ranges of the IP addresses* corresponding to the clients that will work with a request server whose *IP address* and *listening port* are stated as well. The format of this file is:

#IP Range	Request Server IP	Request Server Port
10.54.18.0-10.54.18.254	10.54.18.9	5900
10.35.0.0-10.35.254.254	10.54.18.10	5901

In this way, if a *client* with IP address equal to 10.54.18.10 establishes communication with the *root server*, this last will assign to *client* the configuration of the *request server* with IP address and listening port equal to 10.54.18.10 and 5901, respectively.

2.2.4 Edit the properties of the *server.properties* file of the *root server*

1. **rootserver.host:** here must be specified the IP address where the *root server* application lies.
2. **rootserver.rmi.port:** here must be specified the RMI listening port through which the other modules of the T-arenal system is going to communicate with the *root server*.
3. **rootserver.transfer.port:** here must be specified the listening port through which the file transfer is going to carry out among the components of the T-arenal system and the *root server*.
4. **rootserver.transfer.user:** here must be specified the username that is going to use for the file transfer.
5. **rootserver.transfer.pass:** here must be specified the password of the user defined in the previous step.
6. **rootserver.transfer.max_logins:** here must be specified the maximum amount of connections to perform file transfer that the *root server* will allow at the same time.
7. **rootserver.transfer.fileserver:** here must be specified the protocol to perform the file transfer; until now is uniquely FTP.
8. **rootserver.wait.time.by.solution:** here must be specified the time (in minutes) that the *root server* will wait by a solution once the corresponding execution has finalized.
9. **rootserver.timeout:** here must be specified the time (in minutes) that the *root server* will wait to check the allocated tasks.
10. **rootserver.systemlog.size:** here must be specified the maximum size (in MB) that will have the `system.log` file.
11. **rootserver.errorlog.size:** here must be specified the maximum size (in MB) that will have the `error.log` file.

2.3 Steps to install the *Request Server* module

2.3.1 GNU / Linux - Unix

1. Create the `/usr/local/tarenal` directory.
2. Copy and unzip the `Linux_tarenalrequestserver.rar` file into `/usr/local/tarenal` directory.
3. For changing the RAM amount to use by the *request server*, you must open with a text editor the `/usr/local/tarenal/t-arenalRequestServer.sh` file and in the line 67 to change the values of the next arguments:
 - ↳ **-Xms**: in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be `-Xms64m`.
 - ↳ **-Xmx**: in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be `-Xmx512m`.
4. Grant execution privilege to the `/usr/local/tarenal/t-arenalRequestServer.sh` file.
5. With a text editor to open `/usr/local/tarenal/requestserver/properties/server.properties` file and you perform the corresponding changes (see Section 2.3.3).
6. With a text editor to open `/usr/local/tarenal/requestserver/security.pol` file and to specify the permissions with which the *request server* will be executed (optional).
7. Execute the next command line: `ln -s -f /usr/local/tarenal/t-arenalRequestServer.sh/etc/init.d/t-arenalRequestServer`.
8. Execute the next command line: `update-rc.d t-arenalRequestServer defaults`.
9. Execute the next command line: `/etc/init.d/t-arenalRequestServer start`.
10. For verifying if the *root server* was successfully started, in the `/usr/local/tarenal/requestserver/logs/system0.log` file must be appear “**Completed Request Server Initialization**”.

2.3.2 Windows NT / 2000 / XP

1. Start session as system administrator.
2. Create the **C:\Program Files\tarenal** directory.
3. Copy and unzip the **Windows_tarenalrequestserver.rar** file into **C:\Program Files\tarenal** directory.
4. With a text editor to open the **C:\Program Files\tarenal\requestserver\properties\server.properties** file and to perform the corresponding changes (see Section 2.3.3).
5. With a text editor to open the **C:\Program Files\tarenal\requestserver\security.pol** file and to specify the permissions with which the *request server* will be executed (optional).
6. With a text editor to open the **C:\Program Files\tarenal\updateReg.txt** file and to perform the next modifications:
 - 6.1. **Application:** in this property must be replaced the string *JAVA_PATH* by the path where the Java Runtime Environment is installed. For instance: *C:\Program Files\Java\jre6\bin*.
 - 6.2. **AppParameters:**
 - 6.2.1. Replace the string *SERVER_PATH* by the path where the *request server* is installed, that in this case is **C:\Program Files\tarenal\requestserver**.
 - 6.2.2. Modify the next arguments to custom the RAM use:
 - ☞ **-Xms:** in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be *-Xms64m*.
 - ☞ **-Xmx:** in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be *-Xmx512m*.
 - 6.3. **AppDirectory:** in this property must be replaced the string *SERVER_PATH* by the path where the *request server* is installed, that in this case is **C:\Program Files\tarenal\requestserver**.
7. To perform double click on **C:\Program Files\tarenal\setup.bat** file.

8. For verifying if the *root server* was successfully started, in the `/usr/local/tarenal/request-server/logs/system0.log` file must be appear “Completed Request Server Initialization”.

2.3.3 Edit the properties of the *server.properties* file of the *request server*

1. **rootserver.port:** here must be specified the same RMI listening port established in the **rootserver.rmi.port** property in the *server.properties* file of the *root server*.
2. **rootserver.host:** here must be specified the same IP address established in the **rootserver.host** property in the *server.properties* file of the *root server*.
3. **rootserver.transfer.client:** here must be specified the same protocol established in the **rootserver.transfer.fileserver** property in the *server.properties* file of the *root server*.
4. **requestsserver.host:** here must be specified the IP address where the *request server* application lies.
5. **requestsserver.rmi.port:** here must be specified the RMI listening port through wich the other modules of the T-arenal system is going to communicate with the *request server*.
6. **requestsserver.transfer.port:** here must be specified the listening port through wich the file transfer is going to carry out among the components of the T-arenal system and the *request server*.
7. **requestsserver.transfer.max_logins:** here must be specified the maximum amount of connections to perform file transfer that the *request server* will allow at the same time.
8. **requestsserver.transfer.fileserver:** here must be specified the protocol to perform the file transfer, which can be by SOCKET or FTP.

8.1. If you use FTP protocol:

- 8.1.1. **requestsserver.transfer.user:** here must be specified the username that is going to use for the file transfer.
- 8.1.2. **requestsserver.transfer.pass:** here must be specified the password of the user defined in the previous step.

9. **requestserver.timeout:** here must be specified the time (in minutes) that the *request server* will wait to check the allocated work units.

2.4 Steps to install the *Client* module

2.4.1 GNU / Linux - Unix

1. Create the `/usr/local/tarenal` directory.
2. Copy and unzip the **Linux_tarenalclient.rar** file into `/usr/local/tarenal` directory.
3. For changing the RAM amount to use by the *client*, you must open with a text editor the `/usr/local/tarenal/t-arenalClient.sh` file and in the line 67 to change the values of the next arguments:
 - ✎ **-Xms:** in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be `-Xms64m`.
 - ✎ **-Xmx:** in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be `-Xms512m`.
4. Grant execution privilege to the `/usr/local/tarenal/t-arenalClient.sh` file.
5. With a text editor to open `/usr/local/tarenal/client/properties/client.properties` file and you perform the corresponding changes (see Section 2.4.3).
6. With a text editor to open `/usr/local/tarenal/client/security.pol` file and to specify the permissions with which the *client* will be executed (optional).
7. Execute the next command line: **`ln -s -f /usr/local/tarenal/t-arenalClient.sh /etc/init.d/t-arenalClient`**.
8. Execute the next command line: **`update-rc.d t-arenalClient defaults`**.
9. Execute the next command line: **`/etc/init.d/t-arenalClient start`**.

2.4.2 Windows NT / 2000 / XP

1. Start session as system administrator.
2. Create the **C:\Program Files\tarenal** directory.
3. Copy and unzip the **Windows_tarenalclient.rar** file into **C:\Program Files\tarenal** directory.
4. With a text editor to open the **C:\Program Files\tarenal\client\properties\client.properties** file and to perform the corresponding changes (see Section 2.4.3).
5. With a text editor to open the **C:\Program Files\tarenal\client\security.pol** file and to specify the permissions with which the *client* will be executed (optional).
6. With a text editor to open the **C:\Program Files\tarenal\updateReg.txt** file and perform the next modifications:
 - 6.1. **Application:** in this property must be replaced the string *JAVA_PATH* by the path where the Java Runtime Environment is installed. For instance: *C:\Program Files\Java\jre6\bin*.
 - 6.2. **AppParameters:**
 - 6.2.1. Replace the string *CLIENT_PATH* by the path where the *client* is installed, that in this case is **C:\Program Files\tarenal\client**.
 - 6.2.2. Modify the next arguments to custom the RAM use:
 - ☞ **-Xms:** in this argument you must specify the minimum RAM amount, *e.g.* to use 64 MB will be *-Xms64m*.
 - ☞ **-Xmx:** in this argument you must specify the maximum RAM amount, *e.g.* to use 512 MB will be *-Xmx512m*.
 - 6.3. **AppDirectory:** in this property must be replaced the string *CLIENT_PATH* by the path where the *request server* is installed, that in this case is **C:\Program Files\tarenal\client**.
7. To perform double click on **C:\Program Files\tarenal\setup.bat** file.

2.4.3 Edit the properties of the *server.properties* file of the *client*

1. **client.port:** here must be specified the same RMI listening port established in the **requestserver.rmi.port** property in the *server.properties* file of the corresponding *request server*.
2. **client.host:** here must be specified the same IP address established in the **requestserver.host** property in the *server.properties* file of the corresponding *request server*.
3. **client.timeout:** here must be specified the time (in minutes) that the *client* will wait to request a work unit to the corresponding *request server*.

Chapter 3

Desktop Graphic User Interface

Once the T-arenal system is installed, a *group* and *user* are created by default which cannot be removed. To the *default group*, named Root, the priority and the quota cannot be changed. To the *default user* the group to which belong, the privilege and to disable its account into the system cannot be changed neither. The name, password and the e-mail only can be modified by himself. The data of the *default user* are the next:

✎ **Name:** Root

✎ **Username:** root

✎ **Password:** administrator

3.1 Authenticate into the T-arenal system

To authenticate into the T-arenal system must be have a user account previously created. The following steps must be performed (see Figure 3.1):

1. In the “Basic” tab:
 - 1.1. To introduce the username and password.
 - 1.2. To introduce the IP address of the *root server* of the T-arenal system. As can be noted a configuration previously saved could be chosen.

- 1.3. To introduce the RMI listening port of the *root server* of the T-arenal system.
2. In the “Advanced” tab:
 - 2.1. To select the wished internationalization.
 - 2.2. To select a graphic style to the interface.
 - 2.3. To select the *Save* option to save the performed configuration.
3. To perform double click on the *Ok* button.

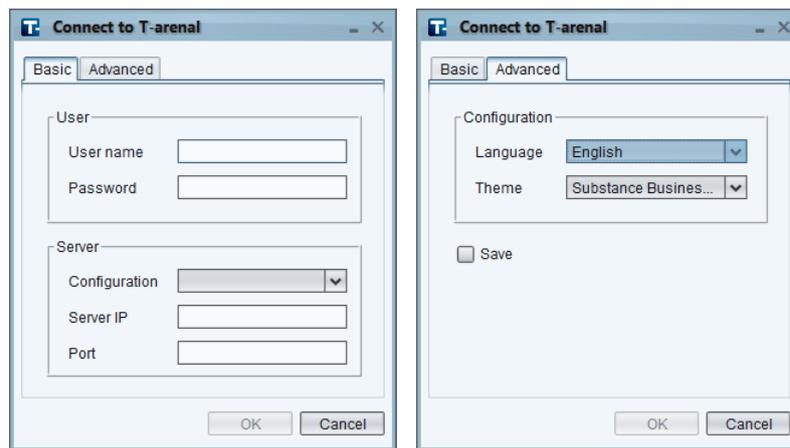


Figure 3.1: Authentication window dialog.

3.2 Graphic Interface

The T-arenal graphic interface is composed by the following parts:

1. **Menu bar:** it presents all functionalities to perform into the system.
2. **Tool bar:** it contains shortcut accesses to some functionalities of the system. On the superior right side there is a menu with different visual styles to change the appearance of the interface.
3. **Main panel:** area where the information requested to the system are shown.

According to the privilege of the authenticated user, a menu and tool bar with the functionalities that the user can perform are created (see Figure 3.2).

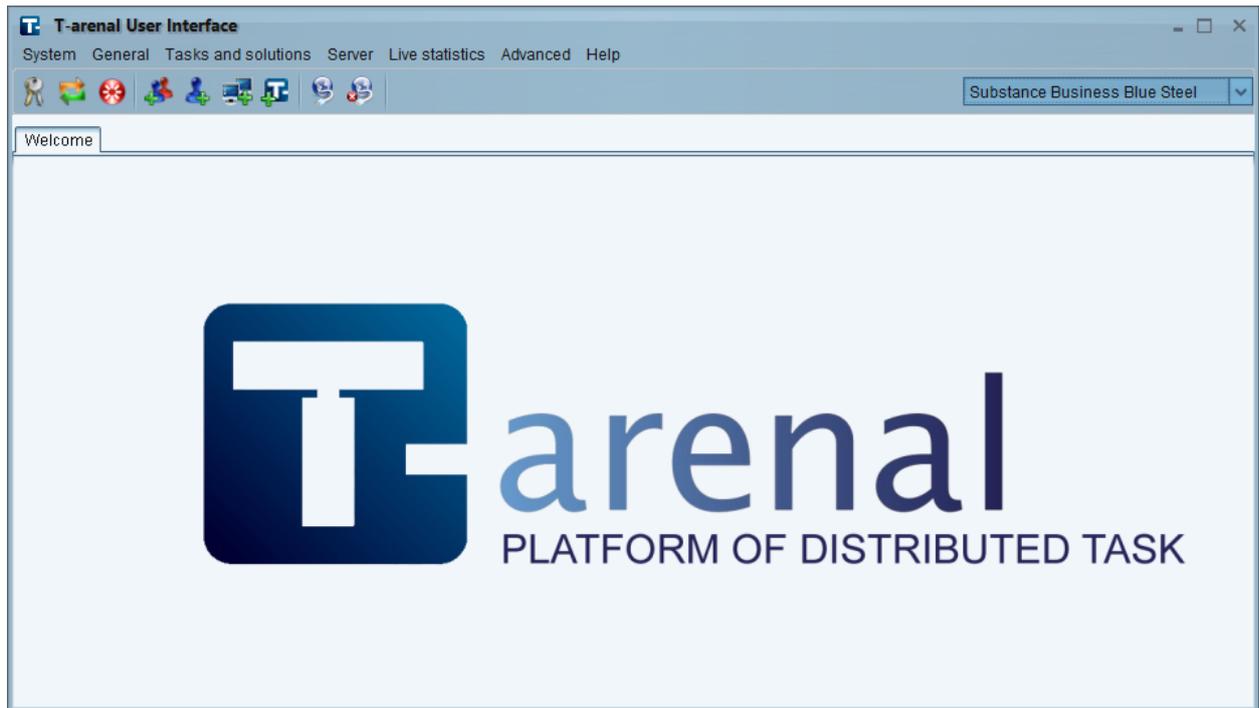


Figure 3.2: Graphic interface corresponding to an user with “**administrator**” privilege.

3.3 Basic functionalities

Update

This functionality has as purpose refresh the information that are shown. To accomplish this, it must perform one the next options:

1. In the menu bar to select the *System* ▸ *Update* item.
2. In the tool bar to do click pon the icon 
3. To press the keyboard *F5*.

Change Password

The goal of this functionality is to allow that the authenticated user has the option to change its password. To this end one of the next steps must be performed:

1. In the menu bar to select the *System* ▷ *Change my password* item.
2. In the tool bar to do click on the icon 

Exit

The goal of this functionality is to exit from the system performing one of the next options:

1. In the menu bar to select the *System* ▷ *Exit* item.
2. To do click in the Close button placed on the superior right side of the title bar.

3.4 Manage User Accounts

This functionalities can be only performed by the administrator users.

3.4.1 Manage Groups

The system is comprised by groups. Each group has a name and description, as well as several users not necessarily with the same privilege.

Add Groups

For adding a group must be performed the next steps (see Figure 3.3):

1. To perform one of these options:
 - 1.1. In the menu bar to select the *General* ▷ *Groups* ▷ *New group...* item.
 - 1.2. In the tool bar to do click on the icon 
 - 1.3. To perform the keyboard combination *Ctrl + G*.
2. Introduce the group name.

3. Introduce a brief description (optional).
4. To do click on the *New...* button to add the users that belong to the group (see Section 3.4.2) (optional).
5. To do click on the *Find...* button to add users that existing into the system (optional).
6. To do click on the *Create* to add the new group into the system.

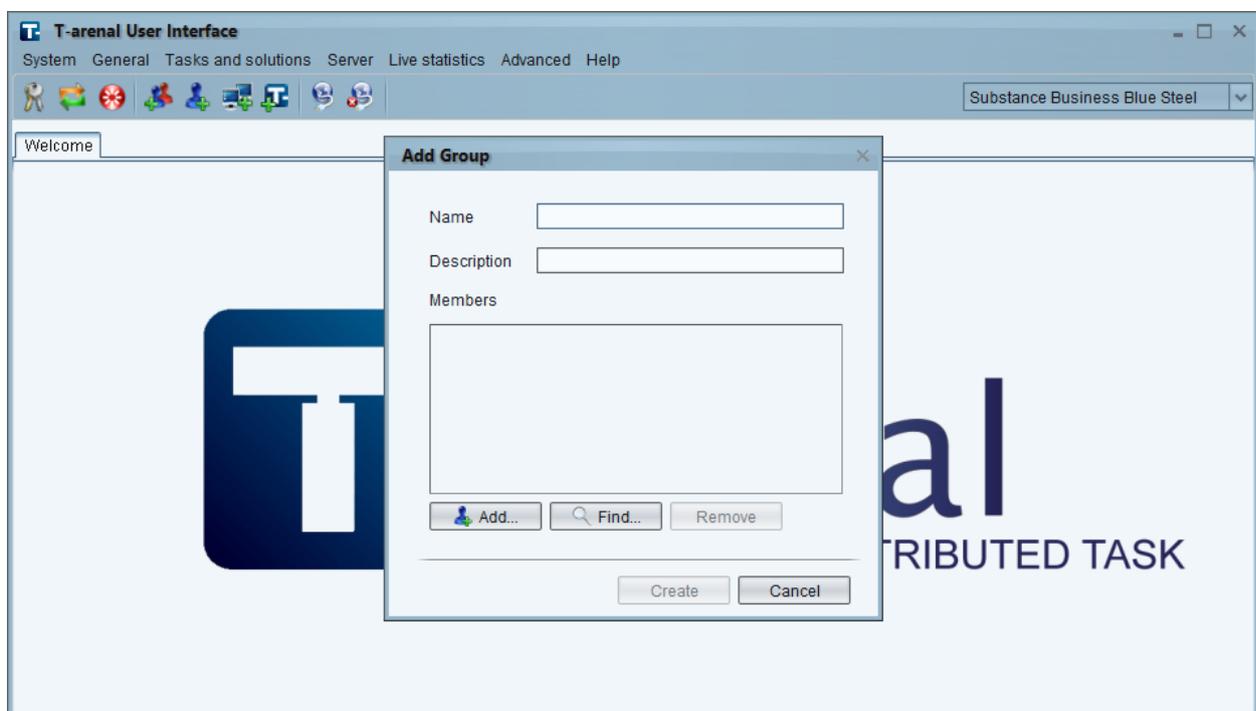


Figure 3.3: Dialog window to add new groups.

Show Groups

To show the groups existing into the system to select in the menu bar the *General* ▷ *Groups* ▷ *All groups* item.

Modify Groups

For modifying a group must be performed the next steps (see Figure3.4):

1. To select the group.
2. To perform one of these options:
 - 2.1. In the menu bar to select the *General* ▷ *Groups* ▷ *Properties* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do double-click on the chosen group.
 - 2.4. To do right click on the chosen group and next to select the *Properties* item.
 - 2.5. To perform the keyboard combination *Alt + Enter*.
3. To modify the description, as well as to add (see Section 3.4.2) or remove users from the group.
4. To do click on the *Apply* or *Ok*.

Remove Groups

To remove one or several groups imply to remove the users that belong to these, as well as the calculation tasks and obtained solutions that the users have into the system. To carry out this operation must be performed the next steps:

1. To select the group(s) to remove.
2. To perform one of following options:
 - 2.1. In the menu bar to select the *General* ▷ *Groups* ▷ *Delete* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen group(s) and next to select the *Delete* option.
 - 2.4. To press the *Suppress* key.
3. To confirm the elimination of the group(s).

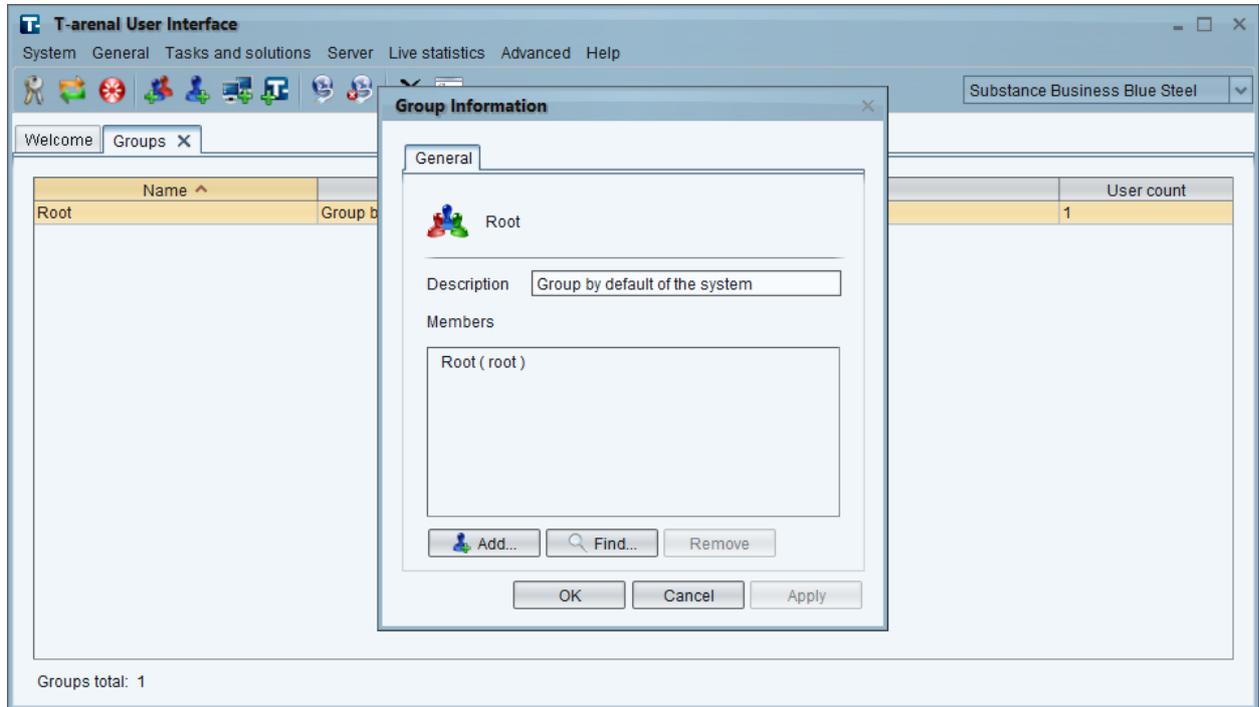


Figure 3.4: Ventana para modificar un grupo.

3.4.2 Manage Users

The users of the system belong to a group and it can perform several functionalities according to its privilege. The users can execute the problems defined into the system whenever these have been assigned. In addition, the users can monitor or stop the progress of the executions (calculation tasks) and download the solutions obtained. The privileges defined for the user are:

- **Guest:** it is the most basic privilege, uniquely allows to the users to perform the next functions: to change password, to access to the problems to which is authorized, to its respective executions and solutions.
- **Problem Administrator:** it privilege allows to perform the previous functionalities, but in addition the users can add or remove new problems.
- **System Administrator:** it privilege allows to the users to perform all functionalities into the system.

Add Users

An user can be added by next two ways:

1. To select the group to which belong. This group can be some existing or a new group that want to be added to the system. In both case a dialog window with a *New...* button is shown, on the which must be performed click to add the new users^{3.5}.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *General* ▷ *Users* ▷ *New user...* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To perform the keyboard combination *Ctrl + U*.

Later to perform on the previous steps to do:

1. In the *General* tab:
 - 1.1. To introduce the complete name.
 - 1.2. To introduce the username.
 - 1.3. To introduce the quota. This value means the amount of executions (calculation tasks) that the user can create as maximum into the system.
 - 1.4. To introduce the e-mail (optional).
 - 1.5. To introduce the password.
 - 1.6. To specify if the user account will be initially enabled.
 - 1.7. To specify the privilege of the user.
2. In the *Problems* tab to chose the problems to which the user is going to have access.
3. In the *Member of* tab to select the group of the user. This tab is shown if the option 2 previously explained is performed.
4. To do click on the *Create* button.

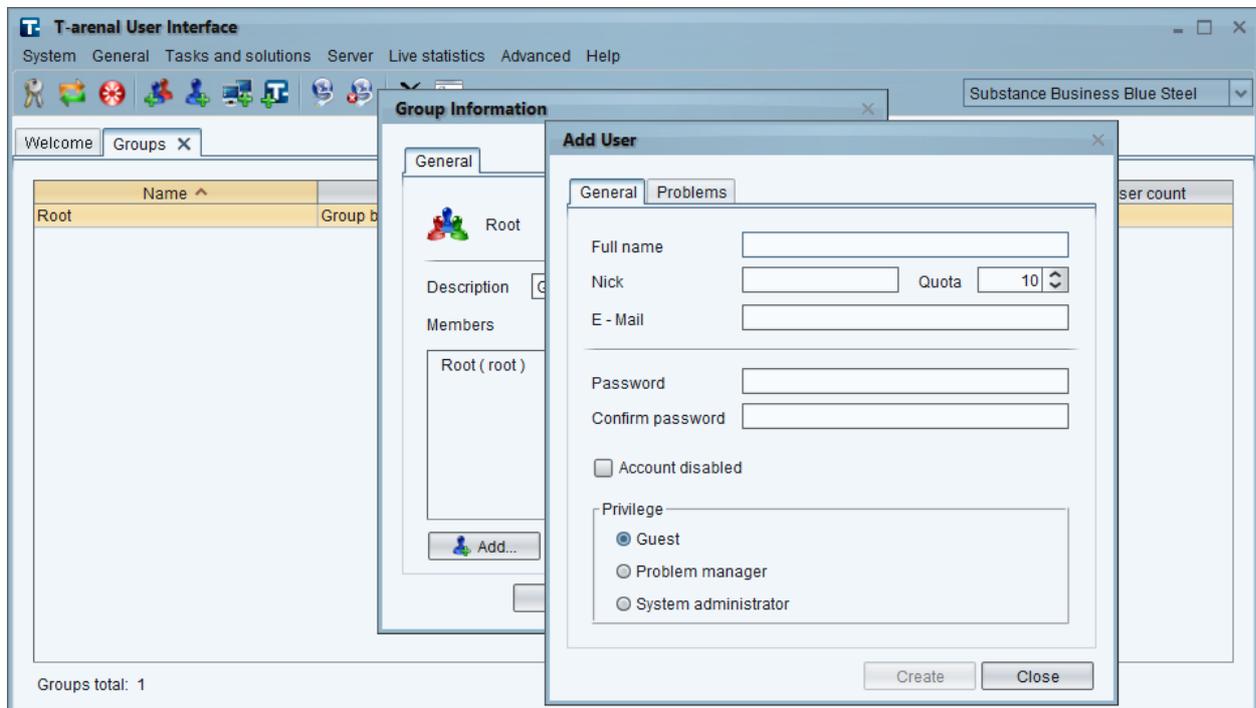


Figure 3.5: Dialog window to add a new user previously selected the group to which belong.

Show Users

To show the users existing into the system to select in the menu bar the *General* ▷ *Users* ▷ *All users* item.

Modify Users

To modify an user must be performed the next steps (see Figure 3.6):

1. To select the user.
2. To perform one of the following options:
 - 2.1. In the menu bar to select *General* ▷ *Users* ▷ *Properties* item.
 - 2.2. In the tool bar to do click on the icon .
 - 2.3. To do double-click on the selected user.
 - 2.4. To do right click on the selected user and next to chose the *Properties* option.

- 2.5. To perform the keyboard combination *Alt + Enter*.
3. Subsequently, it can be modified the name, the quota, the e-mail and the privilege, as well as to manage the problems to which el user accessed. In addition, the user account could be enabled or disabled.
4. To do click on the *Apply* or *Ok* button.

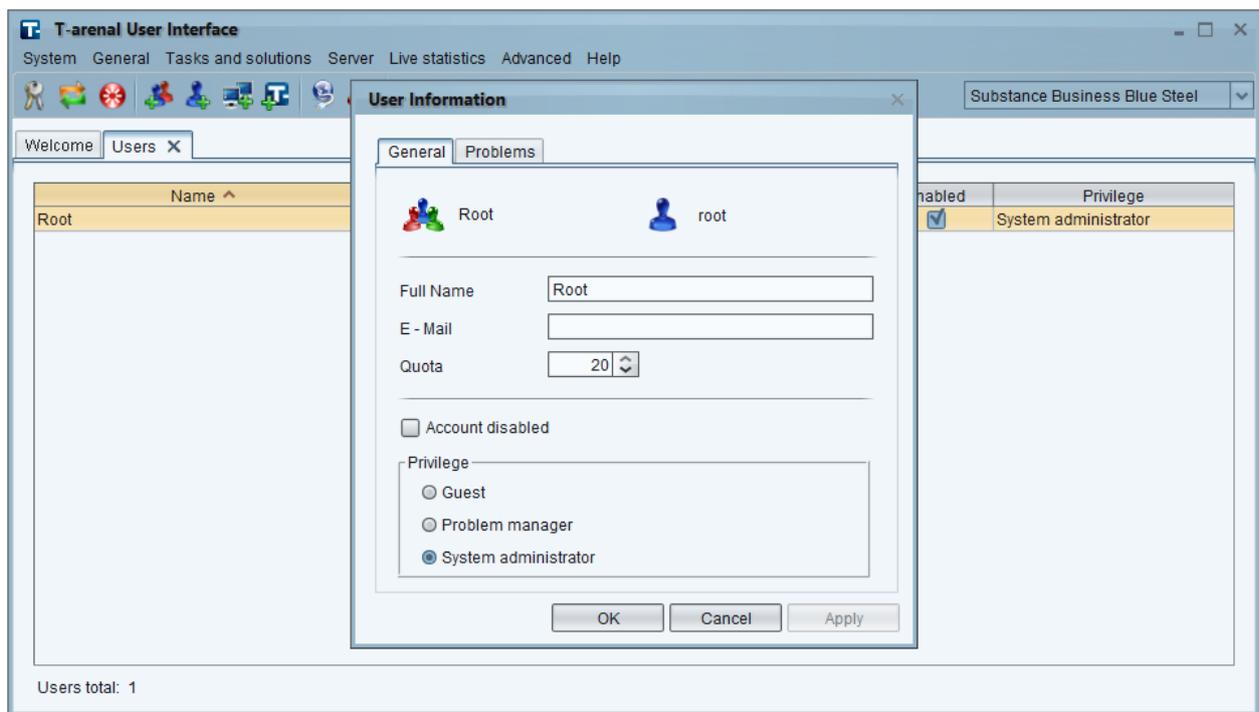


Figure 3.6: Window dialog to modify the user's data.

Change User Password

To change the user password must be performed the following steps (see Figure 3.7):

1. To select the user.
2. To perform one of the next options::
 - 2.1. In the menu bar to select *General* ▷ *Users* ▷ *Change password* item.

- 2.2. To do right click on the chosen user and next to select the *Change password* option.
3. To write the current and the new password.
4. To do click on the *Ok* button.

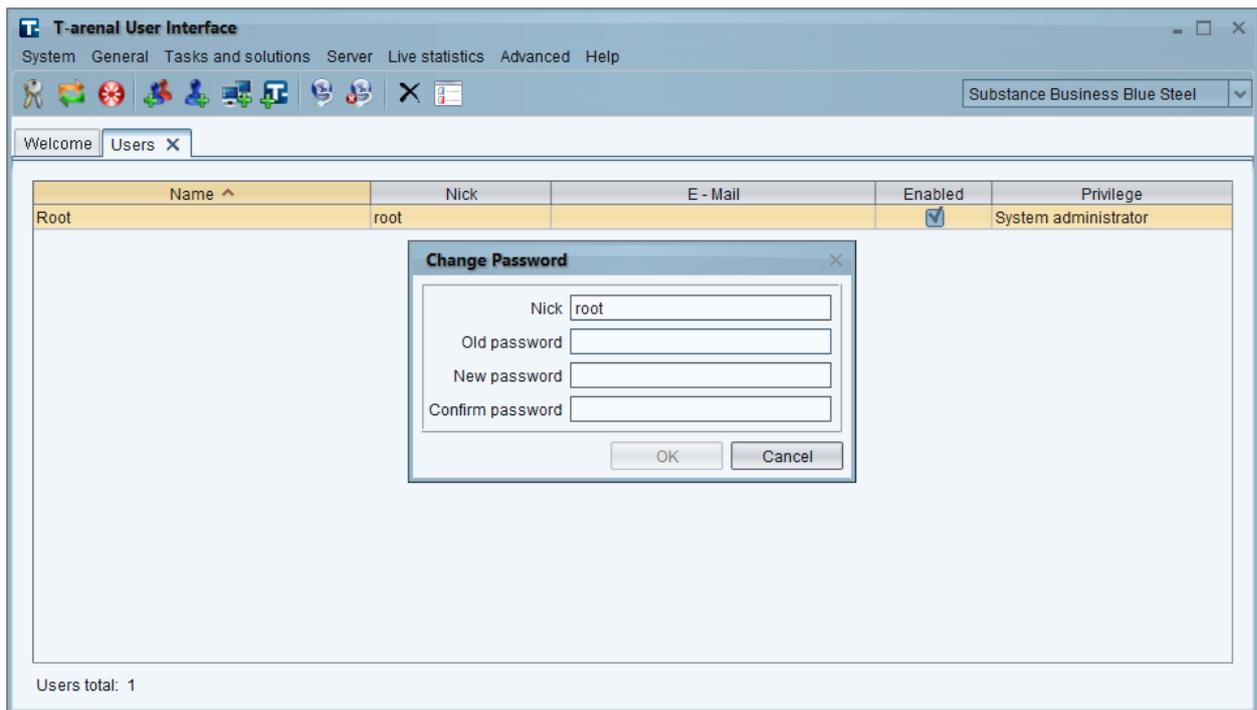


Figure 3.7: Dialog window to change the password of the *root* user.

Remove Users

To remove one or several users imply to remove the corresponding calculation tasks and obtained solutions. To this end the following operations must be performed:

1. To select the user(s) to remove.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *General* ▸ *Users* ▸ *Delete* item.
 - 2.2. In the tool bar to do click on the icon 

- 2.3. To do right click on the selected user(s) and next to select the *Delete* option.
- 2.4. To press the *Suppress* key.
3. To confirm the elimination of the user(s).

3.5 Manage Computational Resources

The computational resources are the workstations where the *client* application lies. This functionalities can be only performed by the administrator users.

3.5.1 Manage IP Ranges

The IP Ranges constitute intervals of IP addresses that are used to group by regions the *clients* belonging to a specific *request server*. In this way, it can be had a better control over the clients that perform requests of work units to its processing.

Add IP Ranges

An IP range is added to a specific *request server* and thus this last must be first selected. To add an IP range the next steps must be performed:

1. If the IP ranges of a specific *request server* are shown, then to do right click and select the *New IP range...* option.
2. If the IP ranges of a specific *request server* are not shown:
 - 2.1. To perform one of the next options:
 - 2.1.1. In the menu bar to select *General* ▷ *IP Ranges* ▷ *New IP range...* item.
 - 2.1.2. In the tool bar to do click on the icon 
 - 2.1.3. To perform the keyboard combination *Ctrl + I*.
 - 2.2. To select the *request server* to which the new IP range is going to add.

Once the previous operations were made, the following steps must be performed (see Figure 3.8):

1. To introduce the IP range name.
2. To introduce the IP address interval (initial and final IP address).
3. To allow or not the IP range. That is, the *clients* that belong to it cannot perform requests of work units to the corresponding *request server*.
4. To do click on the *Create* button.

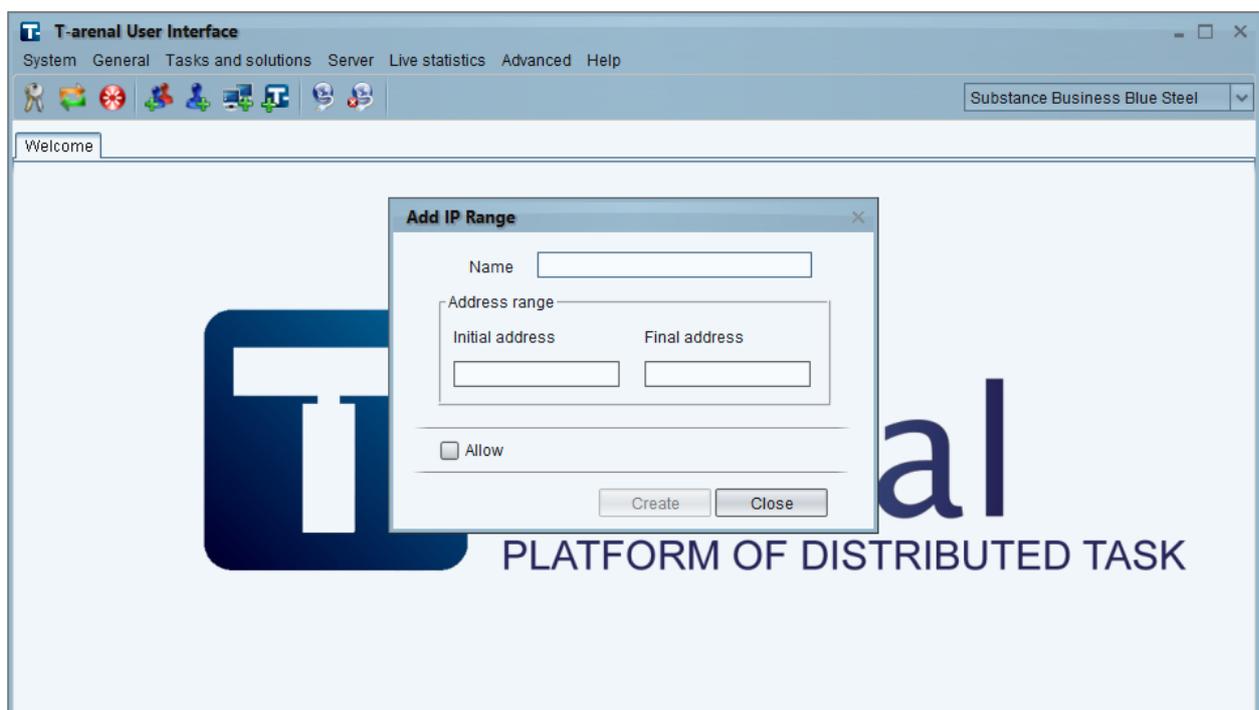


Figure 3.8: Ventana para adicionar rangos IP.

Show IP Ranges

To show the IP ranges belonging to a *request server* of the next steps must be performed:

1. In the menu to select *General* ▷ *IP Ranges* ▷ *All IP ranges* item.
2. To select a *request server*.
3. To do click on the *Select* button.

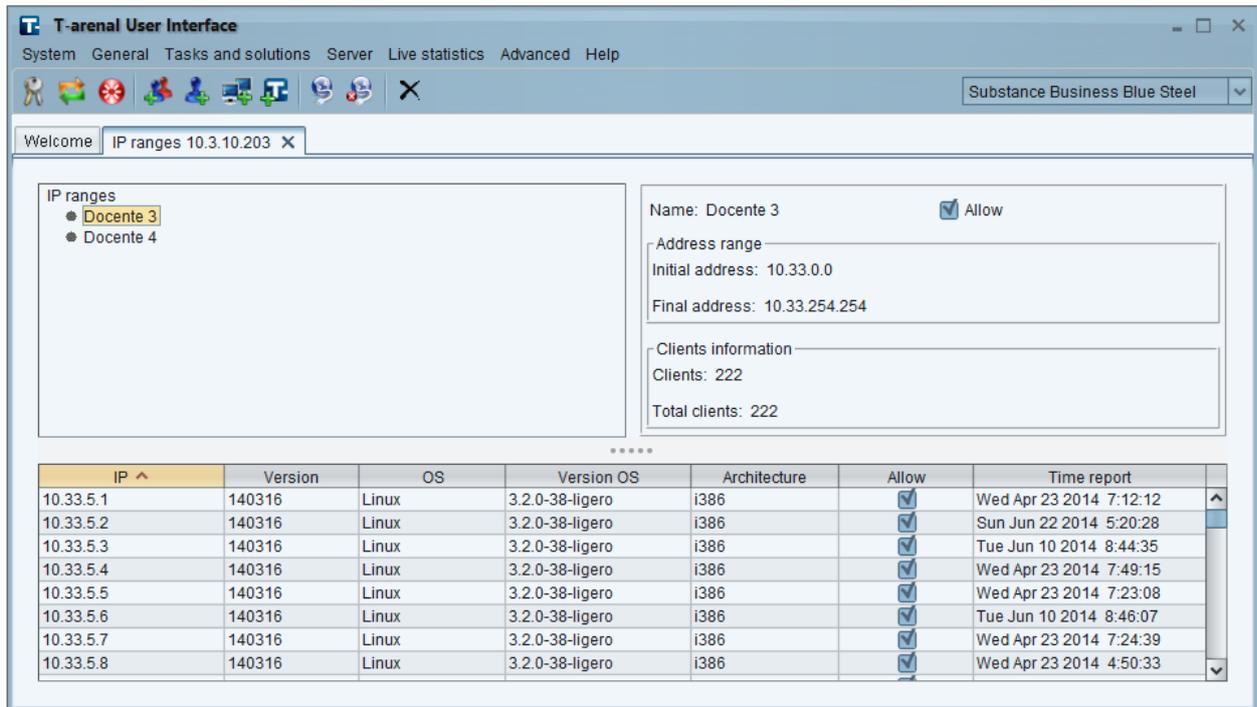


Figure 3.9: View where are shown the data of a *request server*.

Allow IP Ranges

To allow the IP ranges is to authorize or not the corresponding *clients* to request work units to the *request server* to which belong. To accomplish this the next steps must be performed:

1. To show a IP range.
2. In the panel where the IP range data are shown to do click on the *Allow* option.

Remove IP Ranges

When a IP range is removed the *clients* that belong to it is not going to remove as well, but that the *clients* is going to add to the parent IP range to which the IP range to delete belongs. If does not exist this parent IP range, the *clients* are retained into the system but these may not perform requests of work units to the corresponding *request server*. To remove one or several IP ranges the next steps must be carried out:

1. To select the IP range(s). To select more than one IP range the *Ctrl* must be pressed. An IP range contained into another cannot be chosen.
2. To perform one of the next options:
 - 2.1. In the menu bar to select *General* ▷ *IP Ranges* ▷ *Delete* item.
 - 2.2. In the tool bar to do click on the icon .
 - 2.3. To do right click on the chosen IP range(s) and next to select *Delete* option.
 - 2.4. To press the *Suppress* key.
3. To confirm the elimination of the IP range(s).

3.5.2 Manage Clients

The *client* application lies on the workstations, and it is the responsible to request work units to its processing and send back the obtained results. The information of the *clients* are added to the system in so far as that these perform the requests to the corresponding *request server*.

Show Clients

To show the *clients* belonging to a *request server* must be performed the next steps:

1. In the menu bar to select the *General* ▷ *Clients* ▷ *All clients* item.
2. To select a *request server*.
3. To do click on the *Select* button.

Also, other reports related with the authorized or not clients and those reported during a time period can be obtained as well. To this end, in the superior right side there are two options to chose the wished report (see Figure 3.10).

The screenshot shows the T-arenal User Interface window. The title bar reads "T-arenal User Interface". The menu bar includes "System", "General", "Tasks and solutions", "Server", "Live statistics", "Advanced", and "Help". The toolbar contains several icons. The main area shows a tab for "Clients 10.3.10.203". Below the tab, there is a filter section with "All clients" selected, "No filter", and a "1 min" setting. The main table displays the following data:

IP ^	Version	OS	Version OS	Architecture	Allow	Time report
10.33.5.1	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:12:12
10.33.5.2	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Sun Jun 22 2014 5:20:28
10.33.5.3	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Tue Jun 10 2014 8:44:35
10.33.5.4	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:49:15
10.33.5.5	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:23:08
10.33.5.6	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Tue Jun 10 2014 8:46:07
10.33.5.7	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:24:39
10.33.5.8	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 4:50:33
10.33.5.9	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Fri Apr 11 2014 8:13:08
10.33.5.10	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 4:50:05
10.33.5.11	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 4:49:12
10.33.5.12	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 4:49:20
10.33.5.13	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 4:48:06
10.33.5.14	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:31:14
10.33.5.15	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 6:31:01
10.33.5.16	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 7:51:50
10.33.5.17	140316	Linux	3.2.0-38-ligero	i386	<input checked="" type="checkbox"/>	Wed Apr 23 2014 6:12:07

Clients total: 342

Figure 3.10: View where are shown the *clients* reported to a *request server*.

Allow Clients

To allow a *client* is to authorize it or not to request work units to the corresponding *request sever*. To this end, the checkbox belonging to the column “*Allow*” of the table where the *clients* are shown must be selected or unselected.

Remove Clients

To remove one or several *clients* the next steps must be performed:

1. To select the client(s) to remove.
2. To perform one of the following options::
 - 2.1. In the menu bar to select the *General* ▸ *Clients* ▸ *Delete* item.
 - 2.2. In the tool bar to do click on the icon ✕
 - 2.3. To do right click on the chosen client(s) and next to select *Delete* option.

- 2.4. To press the *Suppress* key.
3. To confirm the elimination of the client(s).

3.6 Manage Problems

The problems are stored in the *root server* and from these can be created several executions (calculation tasks). The problems by an algorithm (class that extend from Task) and data manager (class that extend from DataManager) are basically comprised. These functionalities can be only carried out by the users with privilege of “**system administrator**” or “**problem manager**”.

Add Problems

To add a problem must be performed the next steps (ver Figura 3.11):

1. To perform one of these options:
 - 1.1. In the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *New problem...* item.
 - 1.2. In the tool bar to do click on the icon 
 - 1.3. To do the keyboard combination *Ctrl + P*.
2. In the *Problem* tab:
 - 2.1. To introduce the access key.
 - 2.2. To specify the priority. This option is going to be disabled if the user have “**problem manager**” privilege.
 - 2.3. To introduce a brief description of the problem.
 - 2.4. To select .class file corresponding to the Task class.
 - 2.5. To select .class file corresponding to the DataManager class.
 - 2.6. To select .xml file (optional).
 - 2.7. To select the remaining .class files and compile-time libraries employed (optional).

- 2.8. To select those files that are constant for all executions created from this problem (optional).
3. In the *Assigning* tab could be selected the users to which the problem will assigned. It is important to remark, that a new problem will be always assigned to the users with privilege of “**system administrator**”.
4. To do click on the *Ok* button.

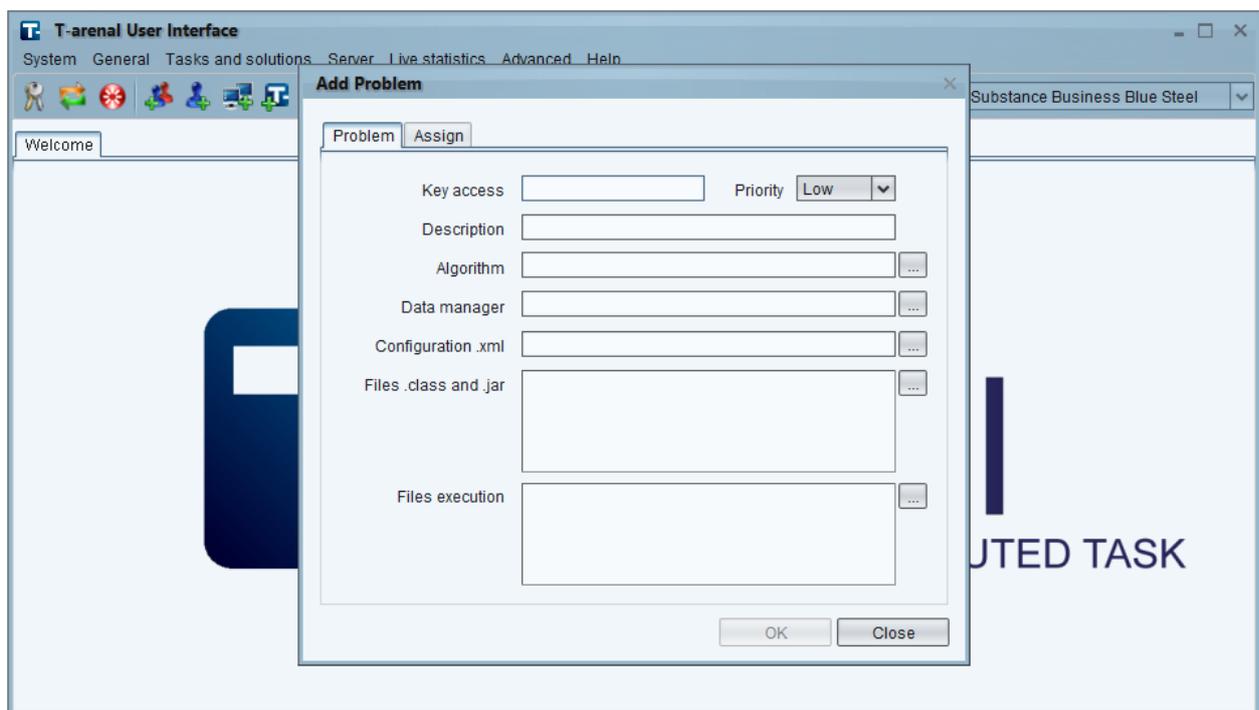


Figure 3.11: Dialog window to add a problem.

Show Problems

To show the problems existing into the system must be performed one of the next steps:

1. If the user is “**system administrator**”, in the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *All problems* item.
2. If the user is “**problem manager**”, in the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *Problems that manage* item.

To show only the assigned problems, in the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *My problems* item. This last option is only available for the users that are not “**system administrator**” due to the fact that these have access to all problems.

Execute Problems

To execute a specific problem must be performed the next steps:

1. To select a problem.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *Execute* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen problem and next to select *Execute* option.
 - 2.4. To press the *F9* key.

If the problem must receive input files for its accomplishment, then a window dialog is going to show to select these files. This window dialog is created from the .xml file specified when the problem was added (see Figure 3.12). Otherwise, a message to confirm the execution of the problem will be show.

Remove Problems

When a problem is removed all executions belonging to it is going to remove as well. To this end the next steps must be performed:

1. To select the problem(s) to remove.
2. To perform one of the following options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Problems* ▷ *Delete* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen problem(s) and next to select the *Delete* option.
 - 2.4. To press the *Suppress* key.

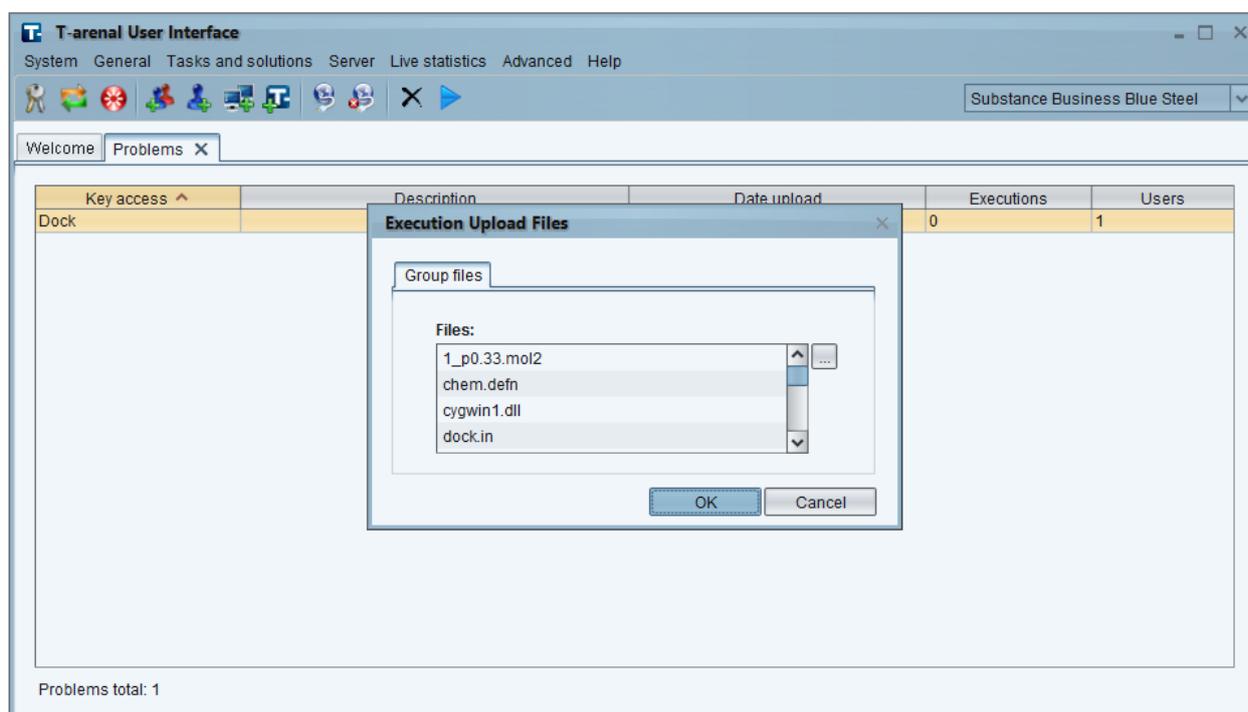


Figure 3.12: Dialog window to upload the input files required by the *Dock* problem.

3. To confirm the elimination of the client(s).

3.7 Manage Executions

The executions are calculation tasks created from specific problems. These are attended by the *request servers* whose *clients* are the responsible of performing. The states that the executions can have are the followings:

- **Waiting:** an execution is in this state when the input files have not been completely transferred.
- **Queued:** an execution is in this state when it is available to be attended by a *request server*.
- **Running:** an execution is in this state when it is being attended by a *request server*.
- **Paused:** an execution is in this state when it has been paused by an user with “**system administrator**” privilege. During this state the execution is retained in the *request server* that attend it but without to create new sub-tasks (work units).

✎ **Finishing:** an execution is in this state when its processing has terminated.

Show Executions

If the authenticated user is “**system administrator**” may show all existing executions into the system, whereby it must select in the menu bar the *Tasks and solutions* ▷ *Executions* ▷ *All executions* item. The user to have only access to the executions started by himself, in the menu bar it must chose the *Tasks and solutions* ▷ *Executions* ▷ *My executions* item.

Monitor Execution Progress

Any user without to take into account its privilege inside the system, it may monitor the progress and the errors of those executions started by him. If the user is “**system administrator**” may monitor all existing executions. To accomplish this the next steps must be performed (see Figure 3.13):

1. To select the execution to monitor its progress.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Executions* ▷ *View status* item.
 - 2.2. To do right click on the chosen execution and next to select the *View status* option.
 - 2.3. To do double-click on the chosen execution.

To show the errors during the execution must be performed the follow:

1. To select the execution.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Executions* ▷ *View errors* item
 - 2.2. To do right click on the chosen execution and next to select the *View errors* option.

Pause/Continue Executions

If the authenticated user is “**system administrator**” can pause or resume an execution. While an execution is paused it cannot create new sub-tasks (work units), albeit those previously created work units is going to process when its respective results being received. To change the state of an execution the next steps must be performed:

1. To select the execution(s).
2. To perform one of the next options::
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Executions* ▷ *Pause/Resume* item.
 - 2.2. In the tool bar to do click on the icon  to pause or on the icon  to resume the execution.
 - 2.3. To do right click on the chosen execution(s) and next to select the *Pause/Resume* option.

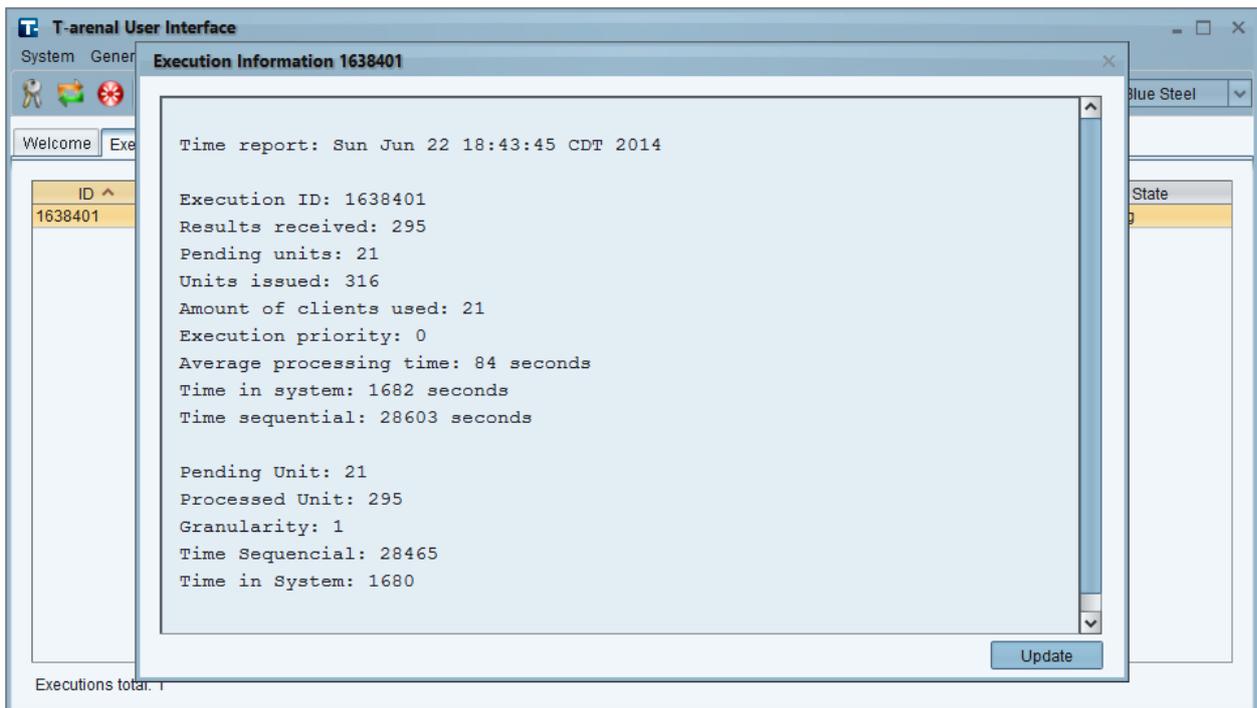


Figure 3.13: Progress of the execution 163401 corresponding to the *Dock* problem.

Stop Executions

To stop one or several executions must be performed the next steps:

1. To select the execution(s).
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Executions* ▷ *Stop* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen execution(s) and next to select the *Stop* option.
 - 2.4. To perform the keyboard combination *Ctrl + S*.
3. To confirm to stop the chosen execution(s).

3.8 Manage Solutions

When an execution finishes its processing into a *request server*, the directory assigned to this is zipped and the obtained file is transferred toward the *root server* of the system to put it available to the corresponding user. The solution name is comprised by a letter followed of the execution identifier. The letters can be:

- ↳ **R:** if the execution successfully finished.
- ↳ **K:** if the execution was stopped by the user to which belongs or by some administrator of the system.
- ↳ **E:** if the execution finished by errors during its processing.

Show Solutions

If the authenticated user is “**system administrator**” may show all existing solutions into the system, whereby in the menu bar must be selected the *Tasks and solutions* ▷ *Solutions* ▷ *All solutions* item. To have only access to its solutions must select in the menu bar the *Tasks and solutions* ▷ *Solutions* ▷ *My solutions* item.

Download Solutions

To download a solution the next steps must be performed:

1. To select the solution.
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Solutions* ▷ *Download* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do double-click on the chosen solution and next to select the *Download* option.
 - 2.4. To perform the keyboard combination *Ctrl + D*.
3. To select the directory where the solution is going to be saved.
4. To do click on the *Save* button.

Remove Solutions

To remove one or several solutions must be performed the next steps:

1. To select the solution(s).
2. To perform one of the next options:
 - 2.1. In the menu bar to select the *Tasks and solutions* ▷ *Solutions* ▷ *Delete* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen solution(s) and next to select the *Delete* option.
 - 2.4. To press the *Suppress* key.
3. To confirm the elimination of the solution(s).

3.9 Manage Client Updates

Add Client Updates

To add a client update must be performed the next steps (see Figure 3.14):

1. To perform one of the following options:
 - 1.1. In the menu bar to select the *Server* \triangleright *Client updates* \triangleright *New update....*
 - 1.2. In the tool bar to do click on the icon 
 - 1.3. To perform the keyboard combination *Ctrl + C*.
2. To introduce the IP range where the client application will be updated.
3. To select the new client version.
4. To do click on the *Ok* button.

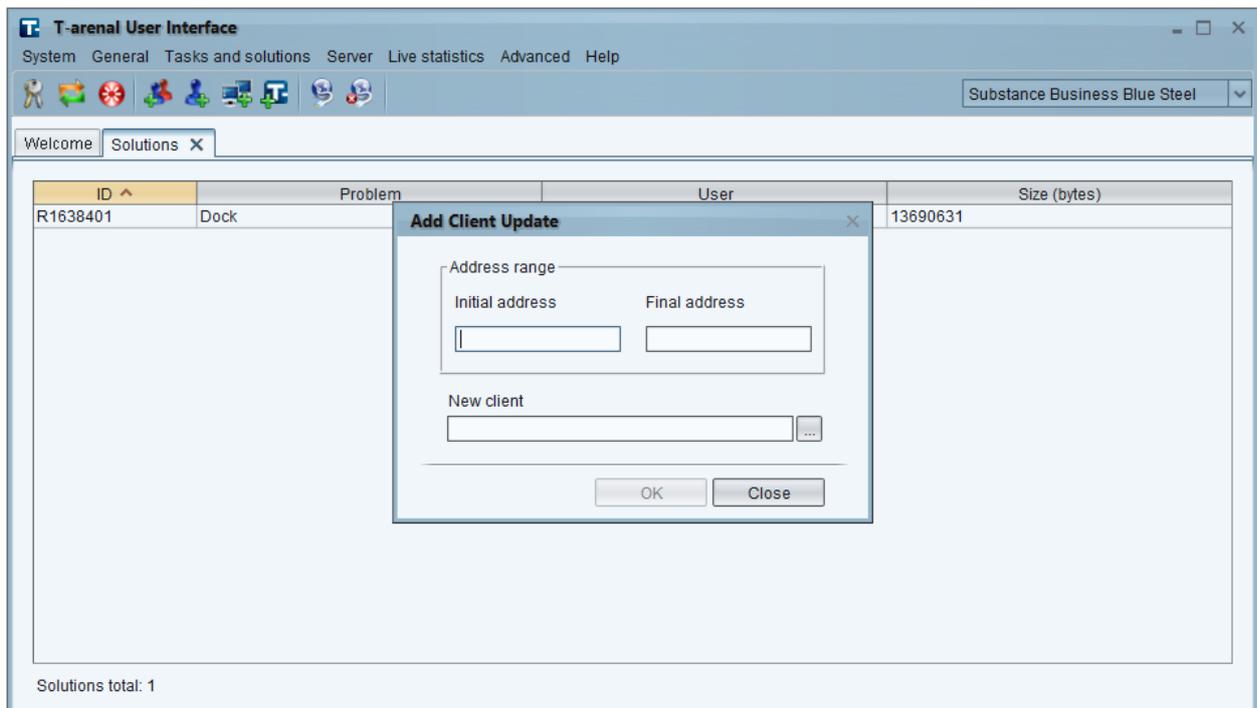


Figure 3.14: Dialog window to add new client updates.

Remove Client Updates

To remove a client update must be performed the next steps:

1. To perform one of the following options:
 - 1.1. In the menu bar to select the *Server* ▷ *Client updates* ▷ *Delete update* item.
 - 1.2. In the tool bar to do click on the icon 
2. To select the client update(s) to remove.
3. To do click on the *Delete* button.

3.10 Root Server Information

To show the *root server* information must be selected in the menu bar the *Server* ▷ *Root server information* item (see Figure 3.15).

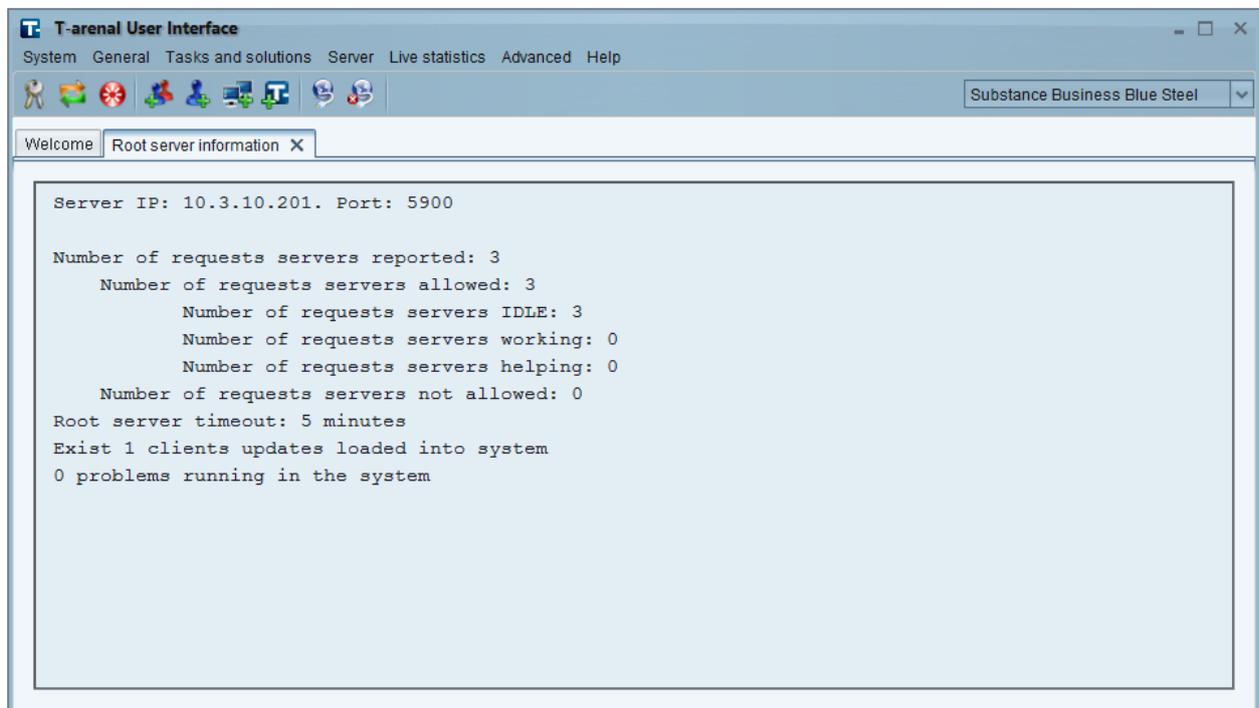


Figure 3.15: Window where the *root server* information is shown.

3.11 Manage Request Servers

The *request servers* are the responsible of carrying out the processing of the executions existing into the system. Therefore, at least one *request server* must exist. When a *request server* establishes communication with the *root server* for the first time, it is added but does not have authorization to attend or collaborate with the processing of the available executions.

Show Request Server

To show the request servers in the menu bar must be selected the *Server* ▷ *Request servers* ▷ *All request servers* item.

Allow Request Servers

To grant or revoke the permission to a *request server* to perform or collaborate in the processing of a calculation task, it must be checked or unchecked the checkbox corresponding to the column “Allow” of the list shown.

Show Request Server Information

From each *request server* the corresponding information can be shown. To this end the next steps must be performed (ver Figura 3.16):

1. To select a *request server*.
2. To perform one of the following options:
 - 2.1. In the menu bar to select the *Server* ▷ *Request servers* ▷ *View information* item.
 - 2.2. In the tool bar to do click on the icon 
 - 2.3. To do right click on the chosen *request server* and next to select the *View information* option.

Eliminar Servidores de Peticiones

To remove one or several *request servers* must be performed the next steps:

1. To select the *request server*(s) to remove.
2. To perform one of following options:
 - 2.1. In the menu bar to select the *Server* ▷ *Request servers* ▷ *Delete* item.
 - 2.2. In the tool bar to do click on the icon .
 - 2.3. To do right click on the chosen *request server*(s) and next to select the *Delete* option.
 - 2.4. To press the *Suppress* key.
3. To confirm the elimination of the *request server*(s).

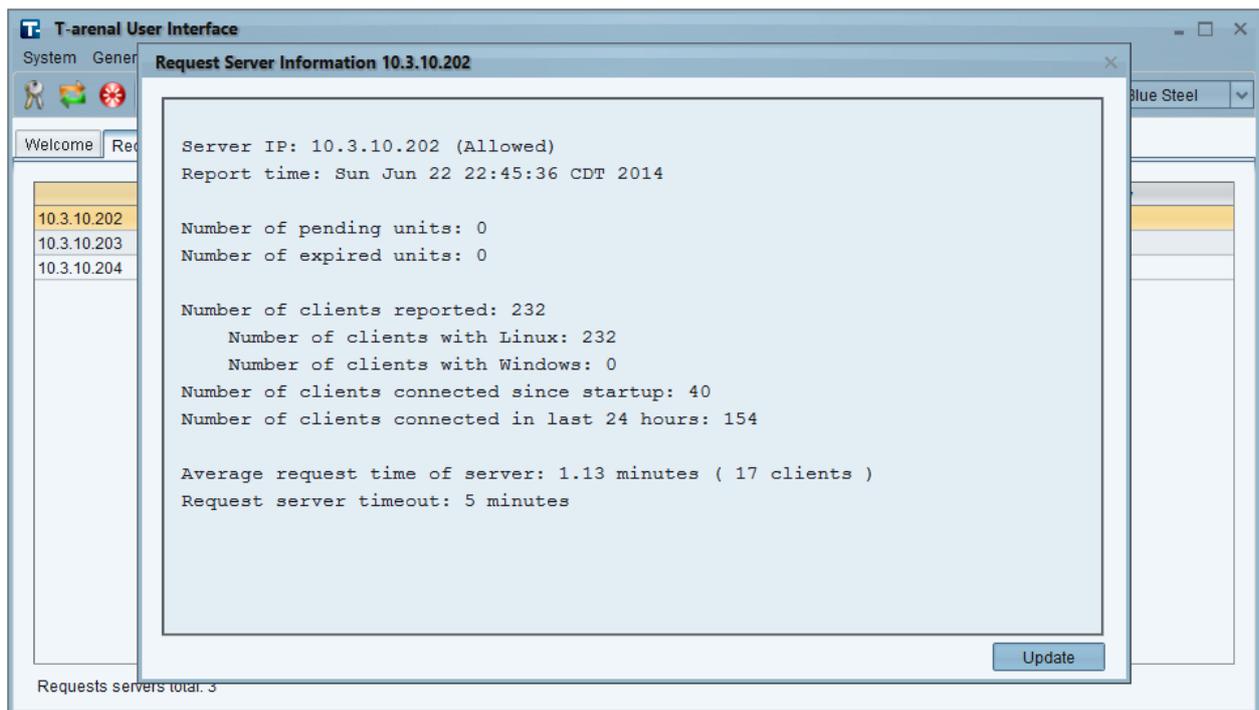


Figure 3.16: Window where the information of a *request server* is shown.