z/TPF V1.1

TPF Users Group - Spring 2009
TPF Debugger Update

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Venue: Development Tools Subcommittee

AIM Enterprise Platform Software
IBM z/Transaction Processing Facility Enterprise Edition 1.1.0

TPF Debugger Update Agenda

- Register by Function
- Register by System Error
- System Error Retry
- Remote Debug Info
- ECB Summary View
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- ALLSVC Macro Group
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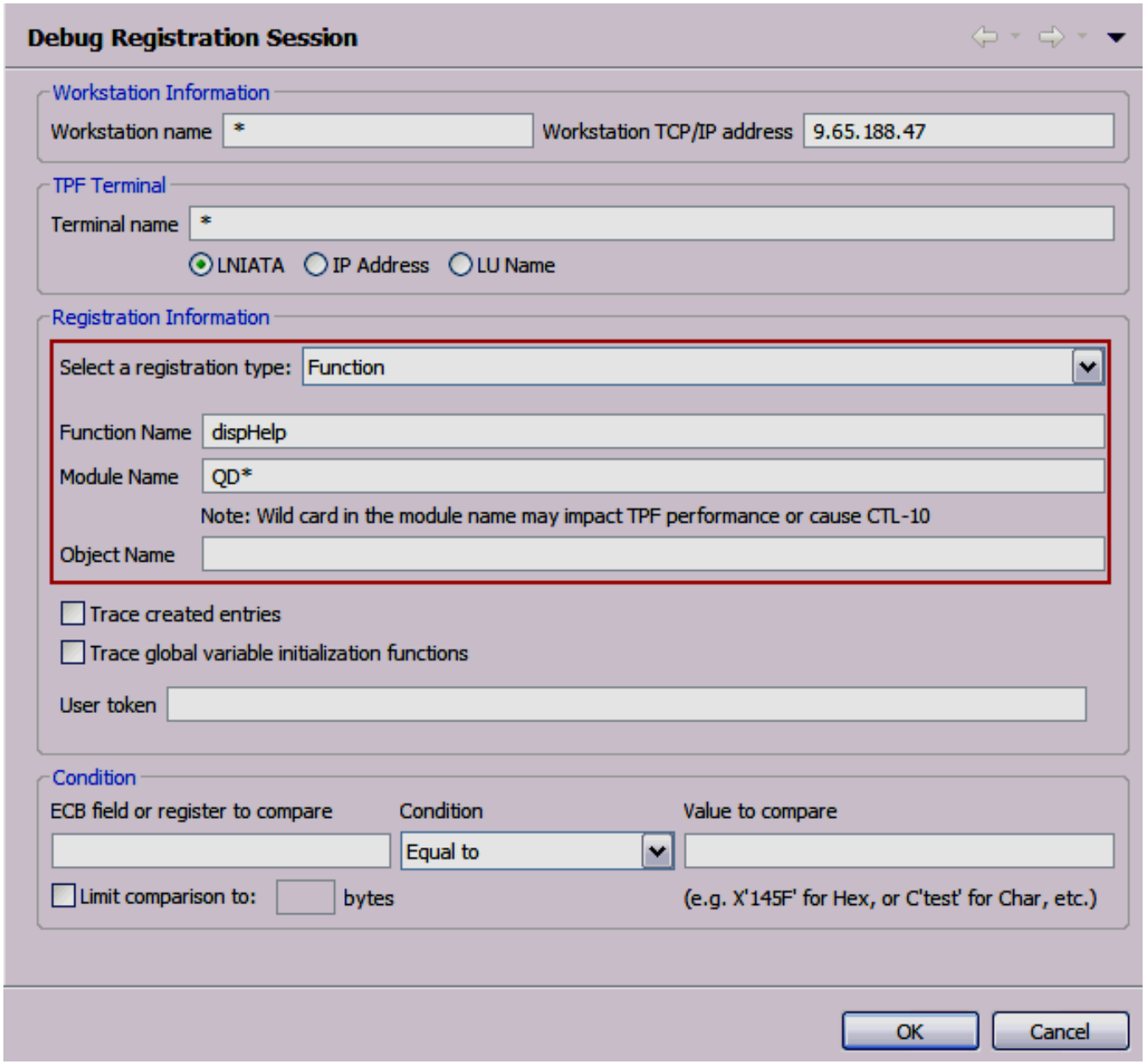
- Add Module (add breakpoint in any module)
- Auto-Stepping (trace run slow)
- Enhanced Fork Support
- Malloc View
- Register by User Defined (transaction trapping)
- Trace Log Enhancement
- Diagnostic Enhancment
- Debugger with heap check mode
- CDBPUX User Exit

Register By Function

- **Debugger starts when the registered ASM, C, or C++ function is entered**
- **TPF Terminal and/or condition can be specified to limit the ECBs that will start the debugger on the registered function**

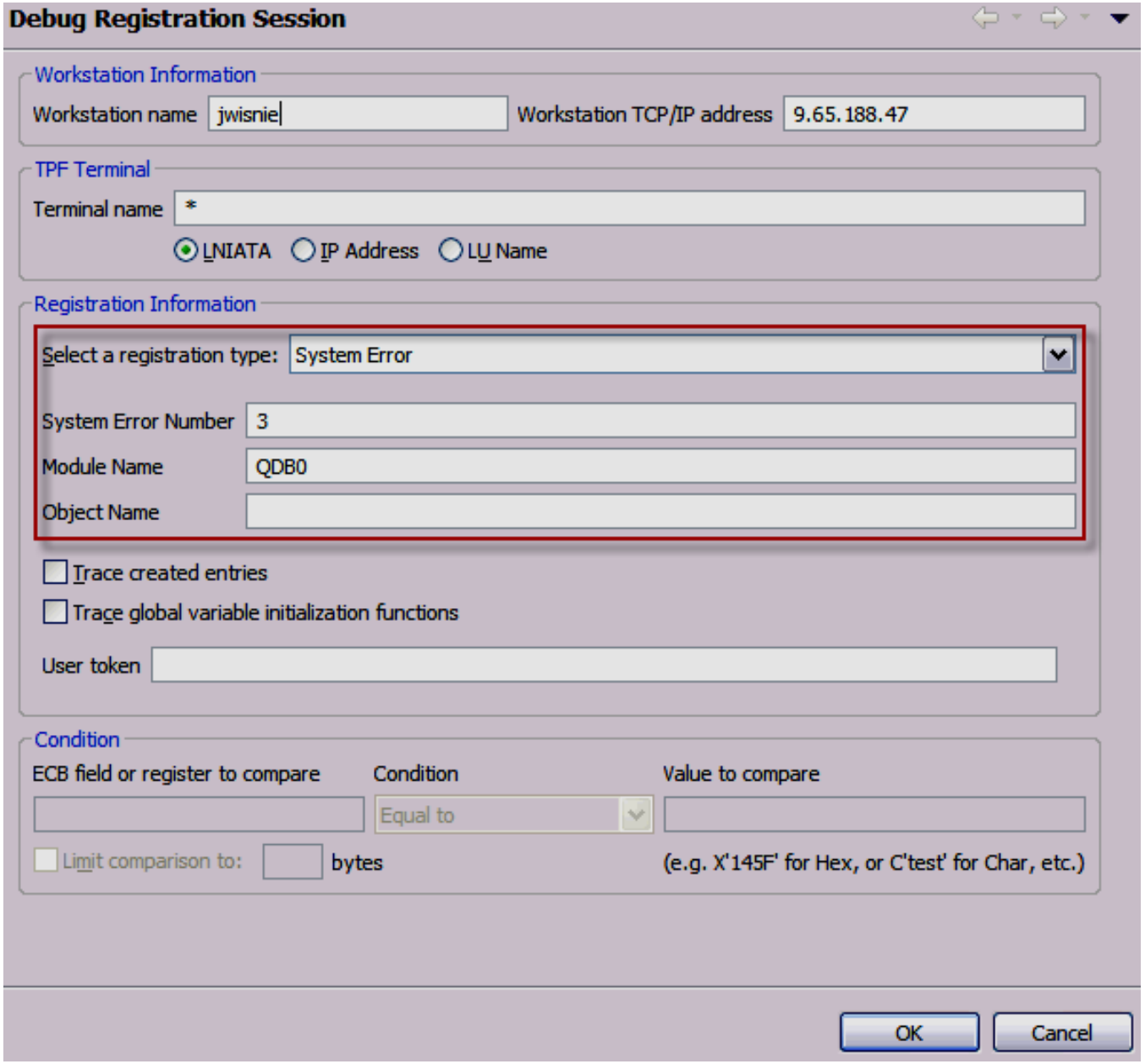


Register By Function

- **Wild card can be specified at the end of the module, object or function.**
- **Module can be specified as “*” but can impact system performance and cause CTL-10 conditions**
- **Class member functions can be specified as “MyClass*::MyGet*”**
- **Mangled function names can be specified ie: _ZN22IVAExceptionBreakpointC1E9IVAString**
- **Conditions can be specified to test parameters passed to a function by specifying the Register to test and the value to test against.**

Register By System Error

- **Debugger starts when the registered system error occurs**
- **TPF Terminal can be specified to limit the ECBs that will start the debugger on the registered by system error**



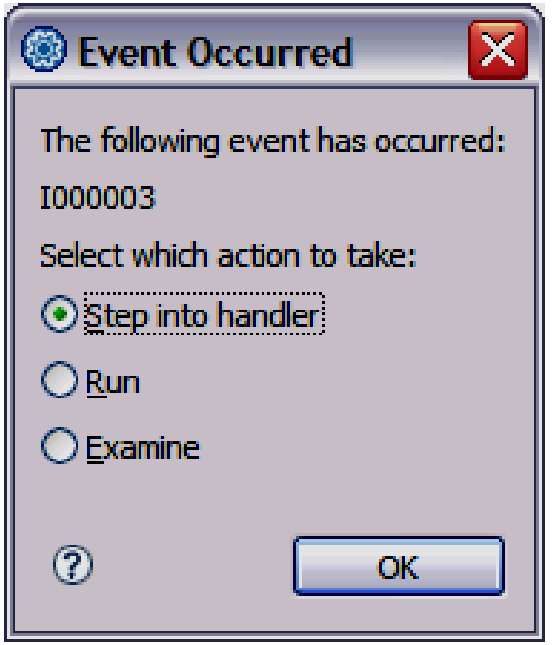
Register By System Error

- **Wild card can be specified for or at the end of the module and object.**
- **Debugger is only started on ECB Dumps (System dumps are not debugged).**
- **Dump number should be specified without the dump prefix and is left padded with zeros. ie OPR-I000003 can be registered as “3”.**
- **SNAPC and SERRC are supported.**

System Error Retry

- **Allows you to avoid taking a system error while using the debugger. The debugger shows the application stopped at system error two different ways**

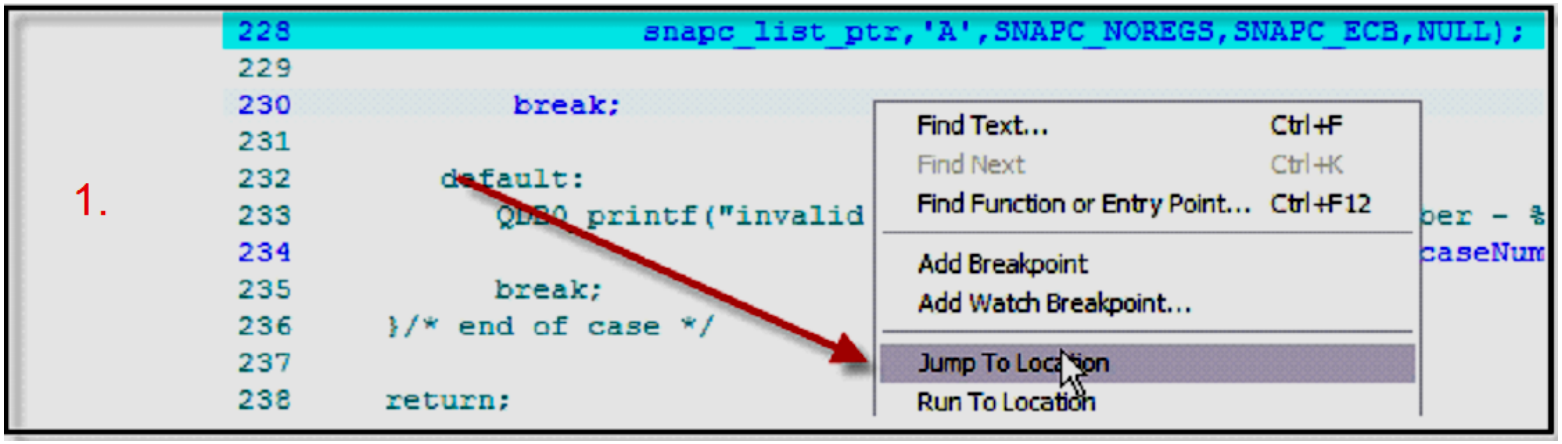
1. **Register by System Error starts the debugger at the location of the system error.**
2. **While using the debugger, a system error occurs and the user is presented with the “Event Occurred” pop up. In this case, the user must choose Examine in order to use System Error Retry.**



System Error Retry

- **This feature allows you to avoid the system error in couple different ways.**

1. Use Jump to location to jump over (bypass) a line causing an error.

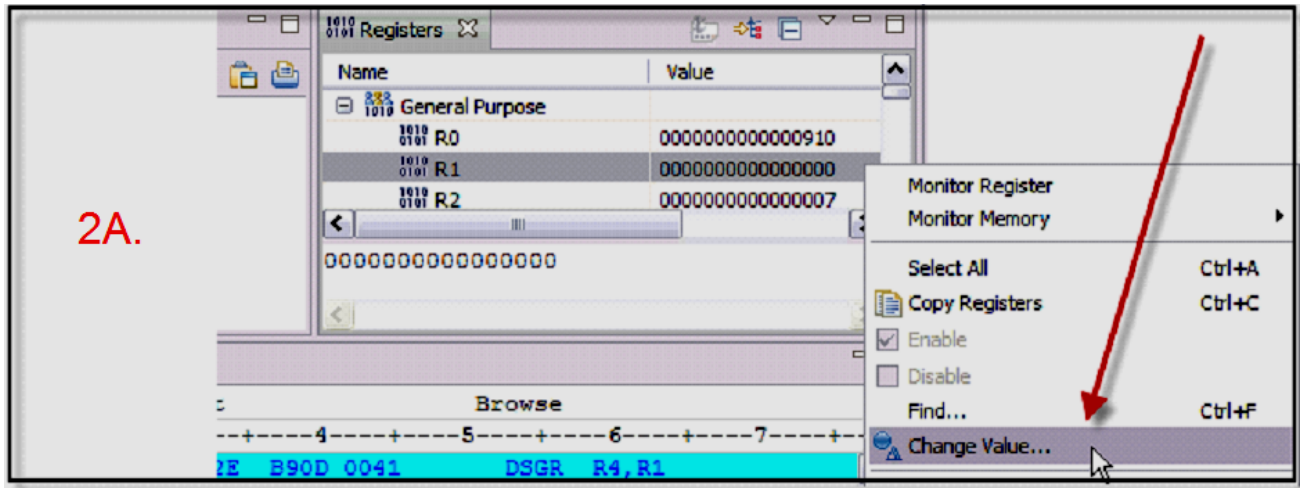


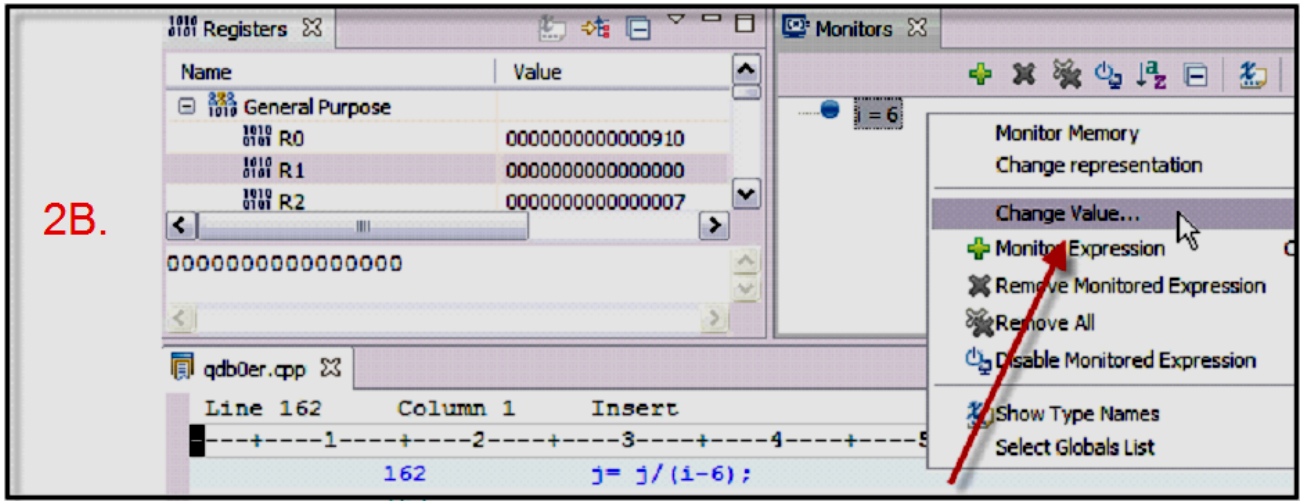
System Error Retry

2. **Modify the registers, variables, or memory that is causing the error.**

2A. If debugging assembler re-execute the instruction.

2B. If debugging C/C++ use jump to location and re-execute the line.





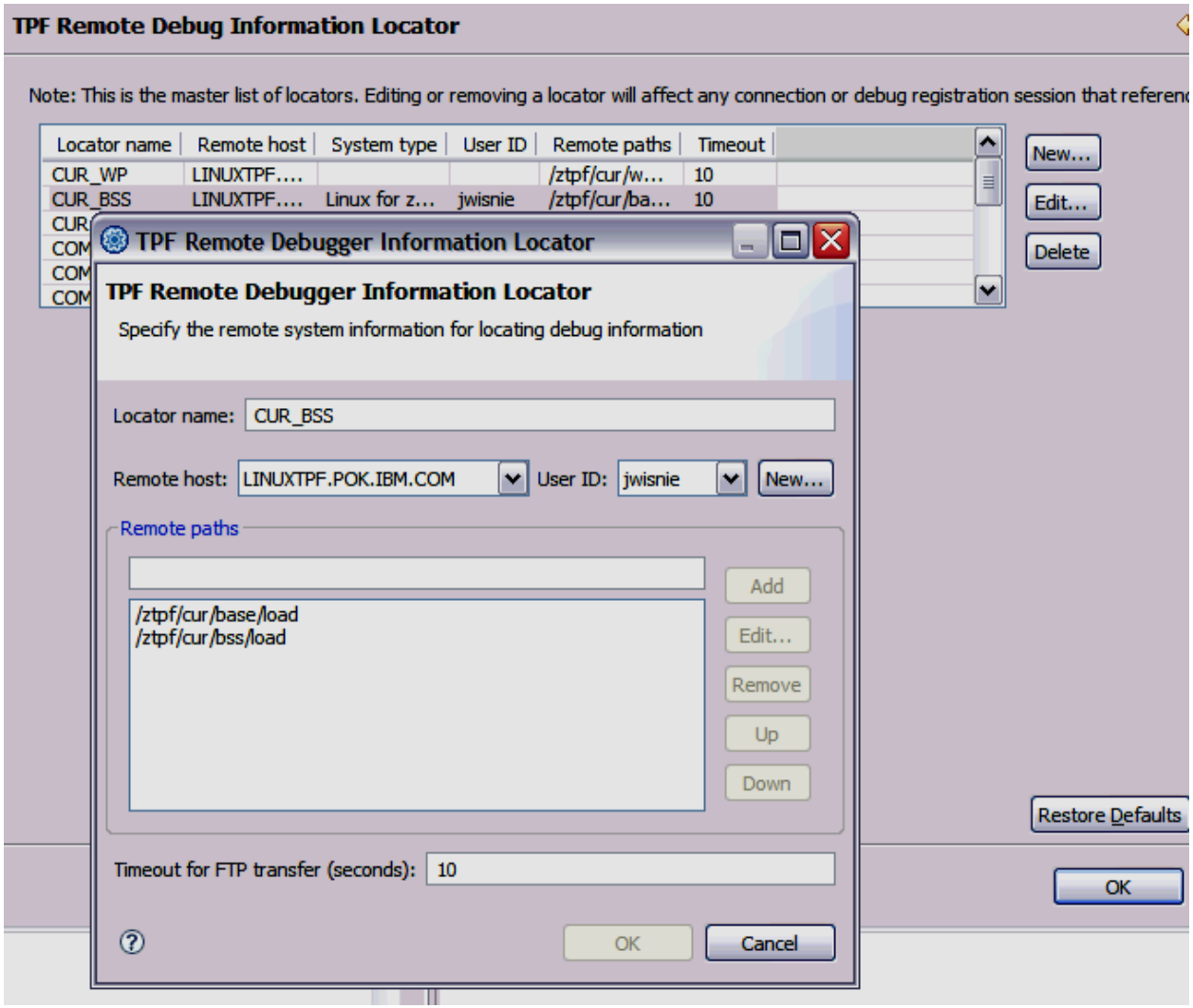
Remote Debug Info

- **Allows you to store your z/TPF debug information files somewhere other than on the TPF file system. However, loading debug information via OLD or TLD is still preferred as it will ensure that the debug information matches the loaded code.**
- **The Debugger detects when a debug information file is not loaded and attempts to FTP the debug information from the remote location.**
- **Multiple FTP paths can be specified but to receive the best performance we recommend 3 or less FTP paths.**
- **Version codes in the PAT are used to find a match on the remote system.**
- **FTPed debug information has the dbgftp suffix. For Example module ABCD with version code ZZ would be FTPed to /tpfdbgelf/ab/abcd/ABCDZZ.dbgftp**
- **FTPed debug information will be deleted if the debug information is loaded by OLD or TLD.**

Remote Debug Info

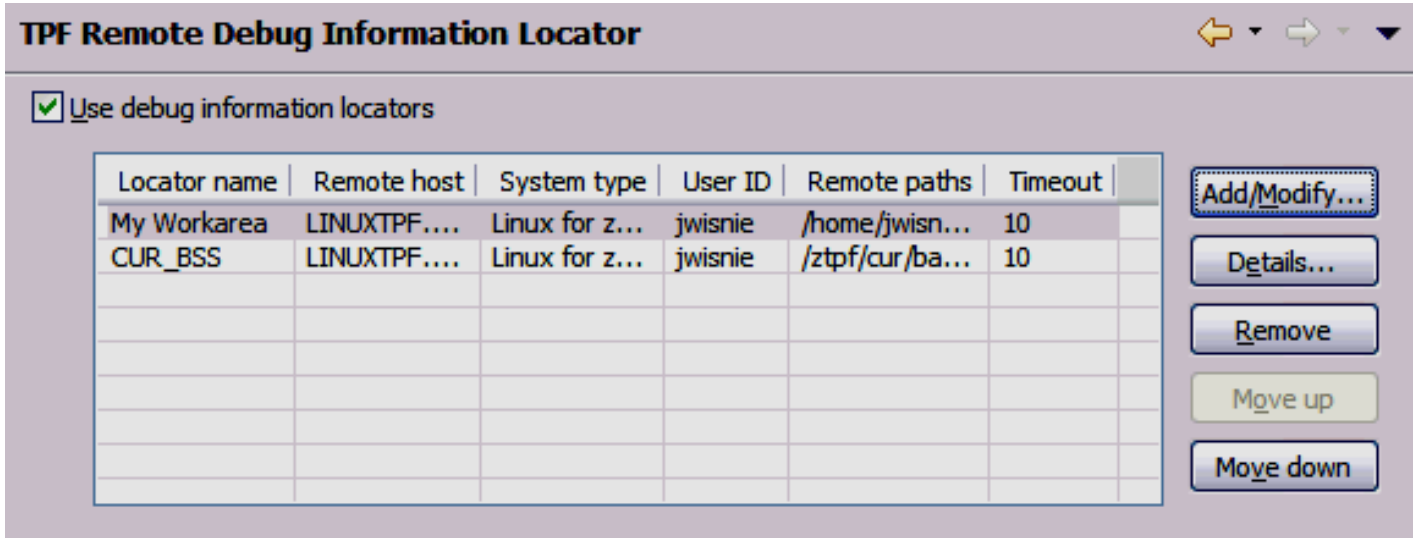
To use the Remote debug info feature

1. **Create the "locators" from the menu option Windows-> Preferences-> Run/Debug->TPF Remote Debug Information Locator. Locators specify the Remote Host name, Fully qualified path, User Id, Password, and time out value.**



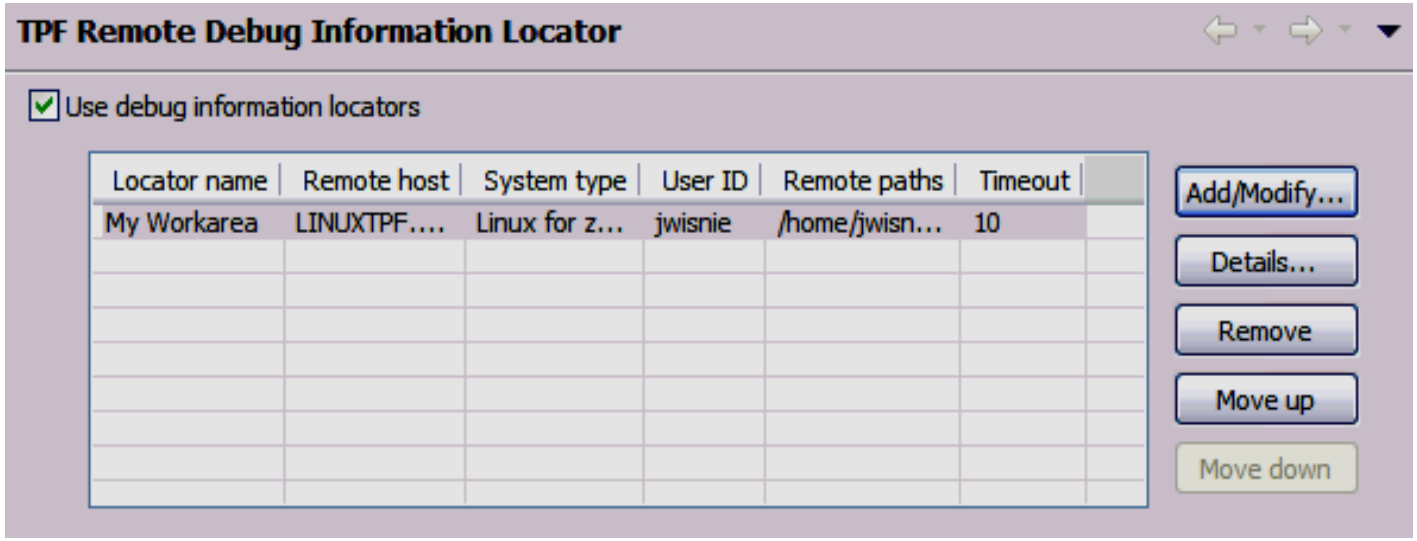
Remote Debug Info (TPF Connection)

2. **Right click the TPF Connection from the RSE and choose properties. Add the locators in the search order desired. These locators will be used by default for the debug sessions, dump viewer, and ECB monitor.**



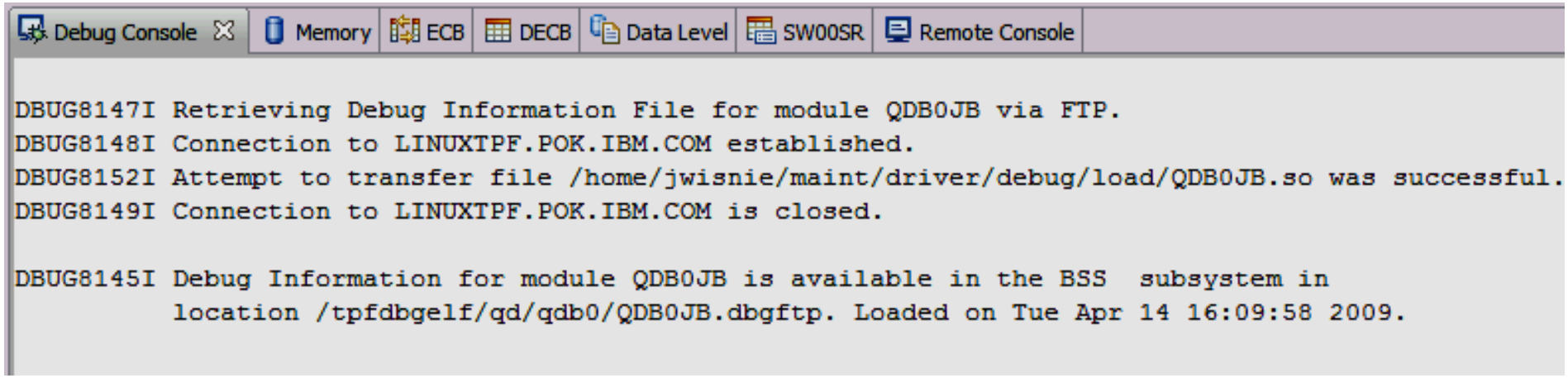
Remote Debug Info (Debug Session)

3. **The locators can be customized for each Debug Session regardless of the settings at the Connection level. Right click the Debug Session from the RSE and choose properties. Add the locators in the search order desired.**



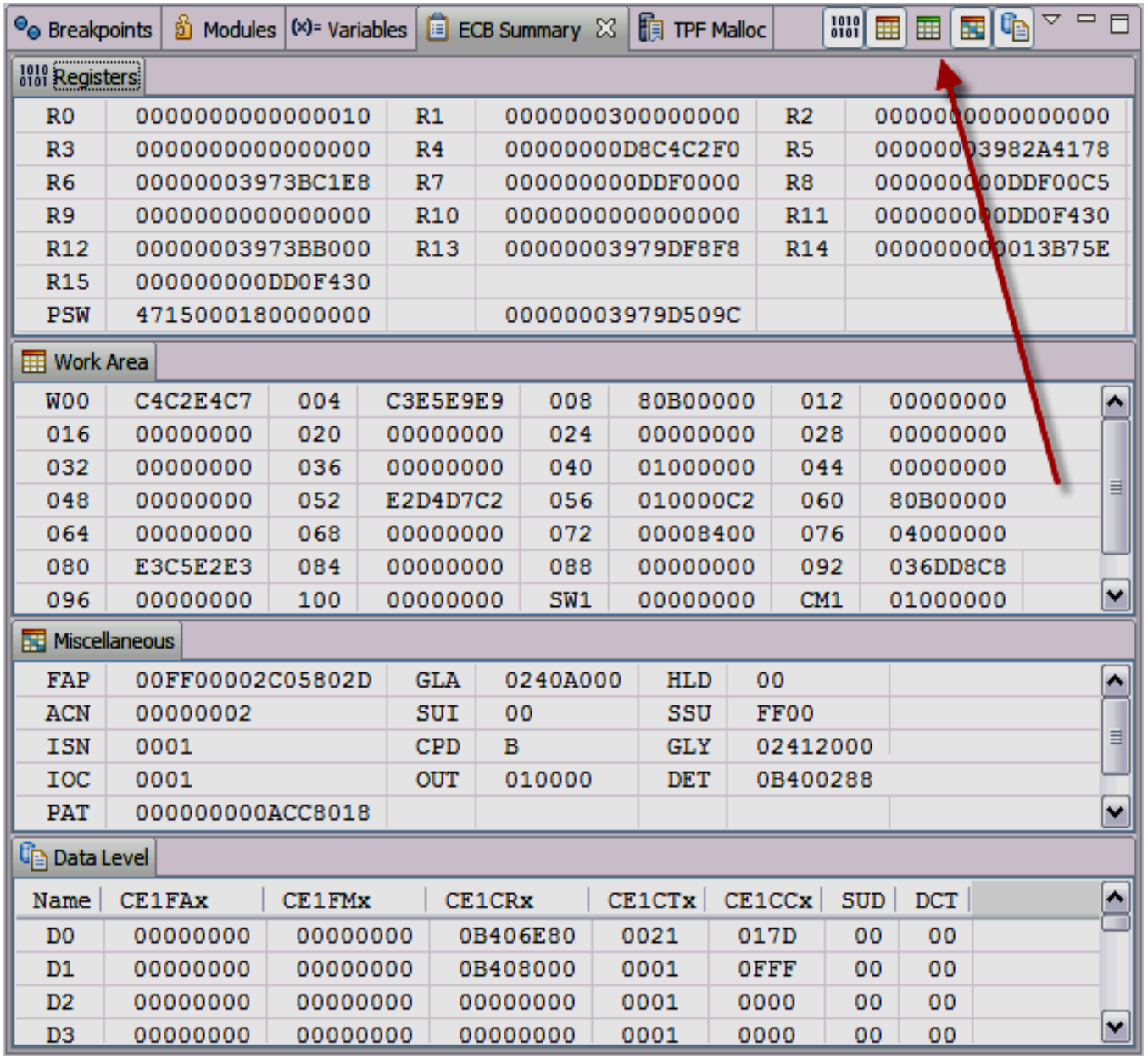
Remote Debug Info (Debug Session)

- **Debug console messages are now sent to the TPF Toolkit to notify the user if debug information could be located and what debug information file was used.**



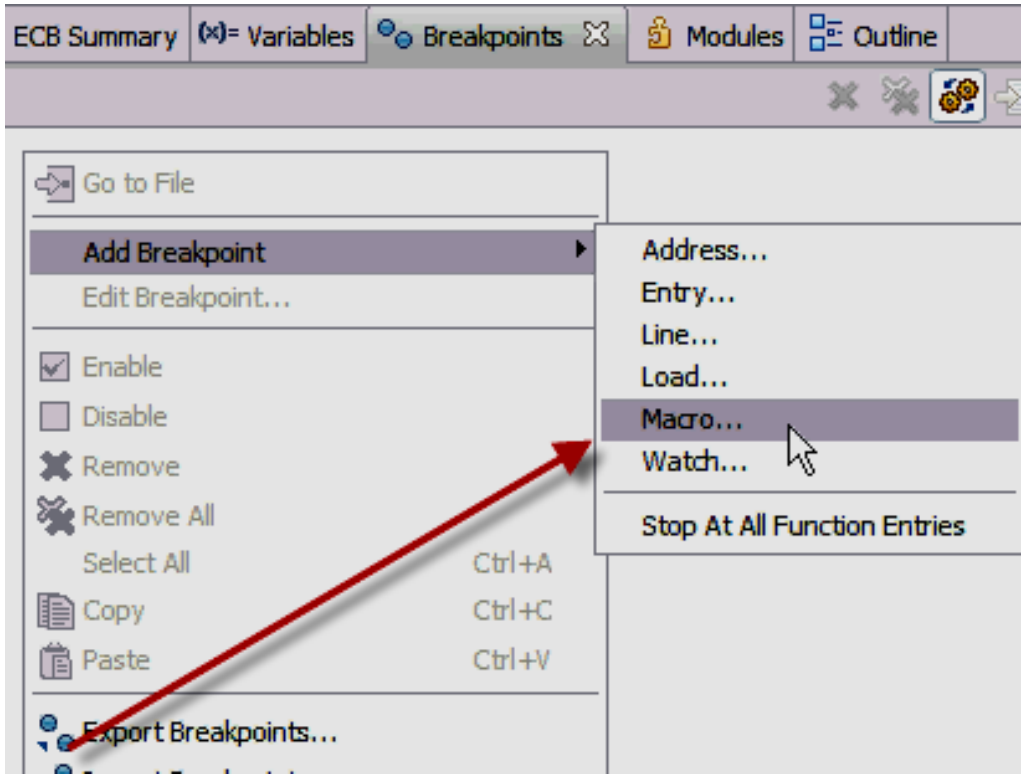
ECB Summary View

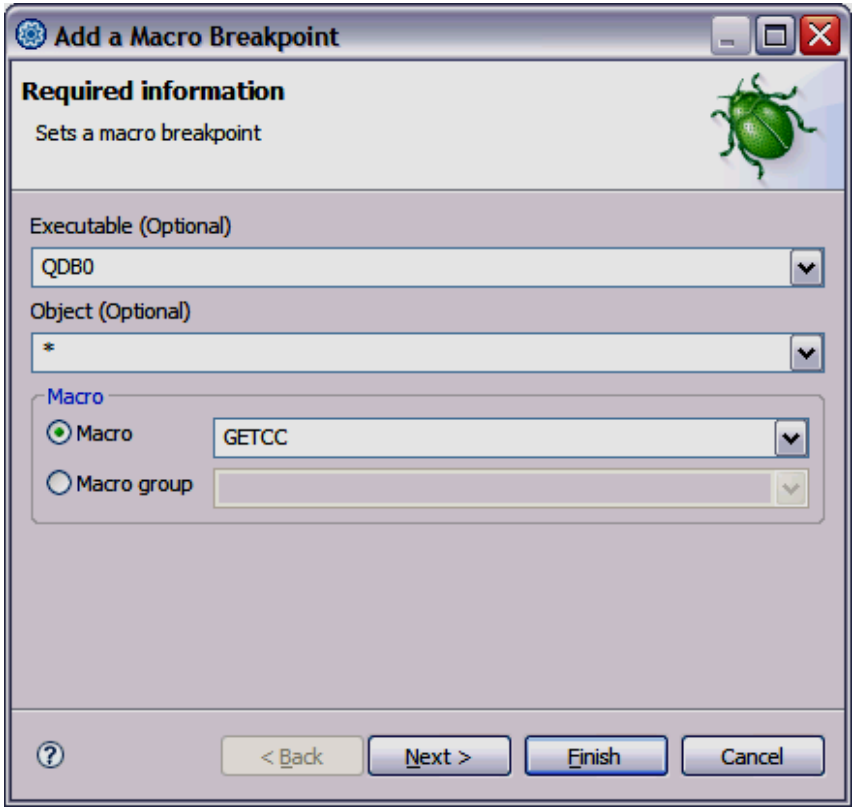
- **Quick view of common ECB areas**
- **Backed by XML for easy customization**
- **Individual panes can be toggled on and off**
- **Control and floating point registers are available at right click of the registers pane**



Add Macro Breakpoint

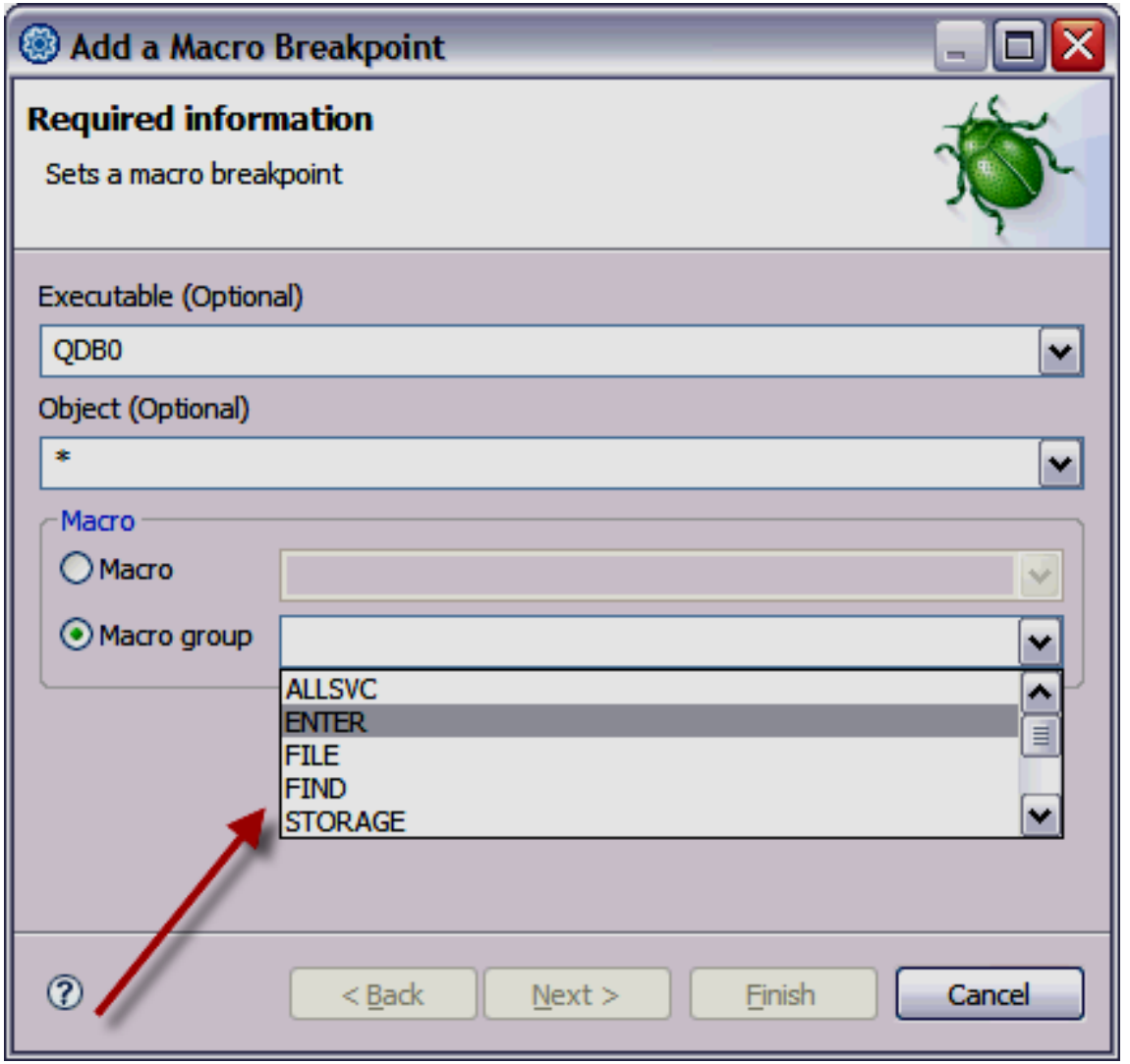
- **Macro Breakpoints now have their own dialog box which is available by right clicking in the breakpoint view (choosing Entry breakpoint and Defer is no longer required).**





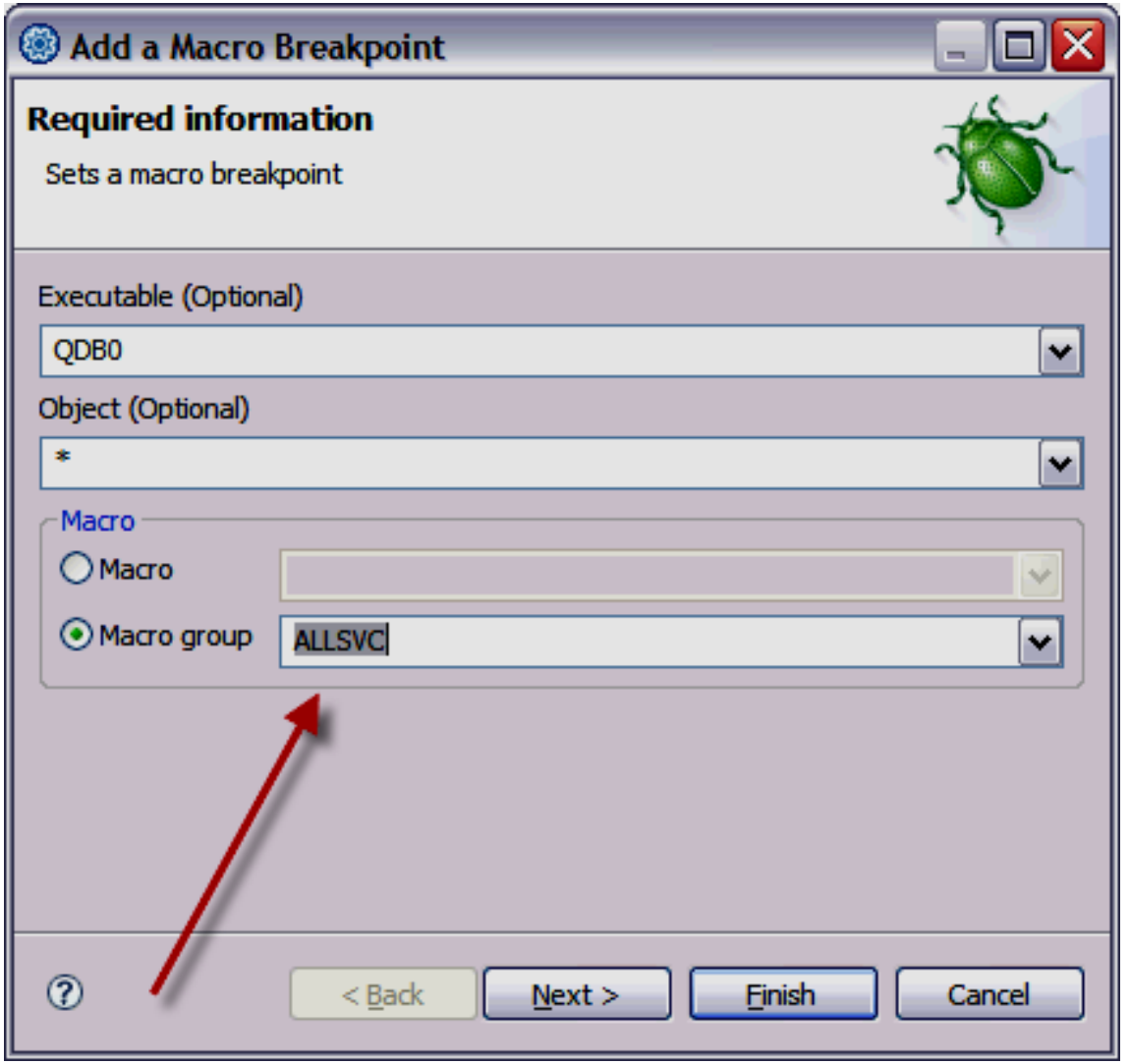
Macro Group List

- **Clicking the drop down arrow provides a list of all available Macro Groups.**



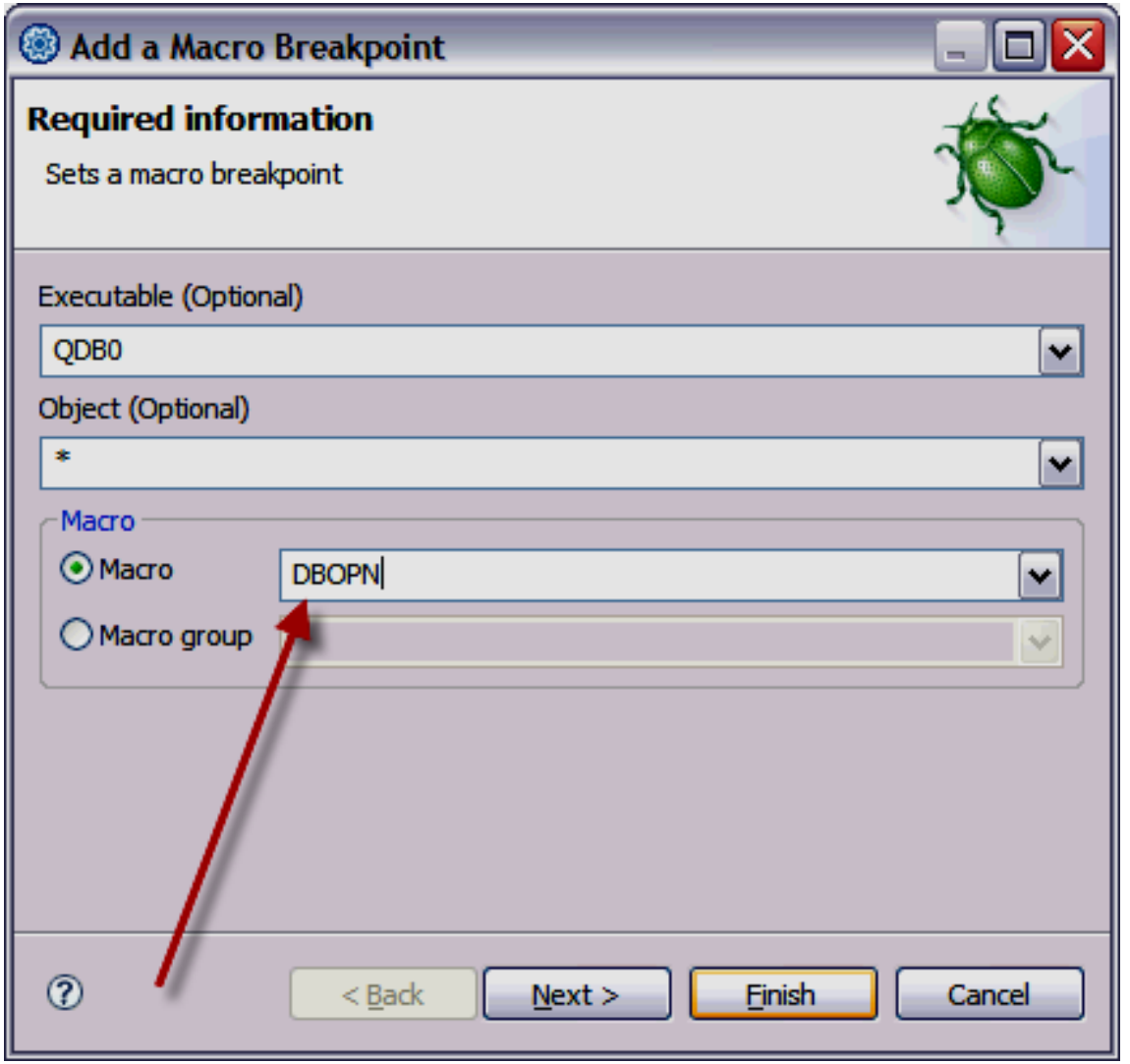
ALLSVC Macro Group

- **The ALLSVC Macro Group will stop the application for All SVC type Macros**



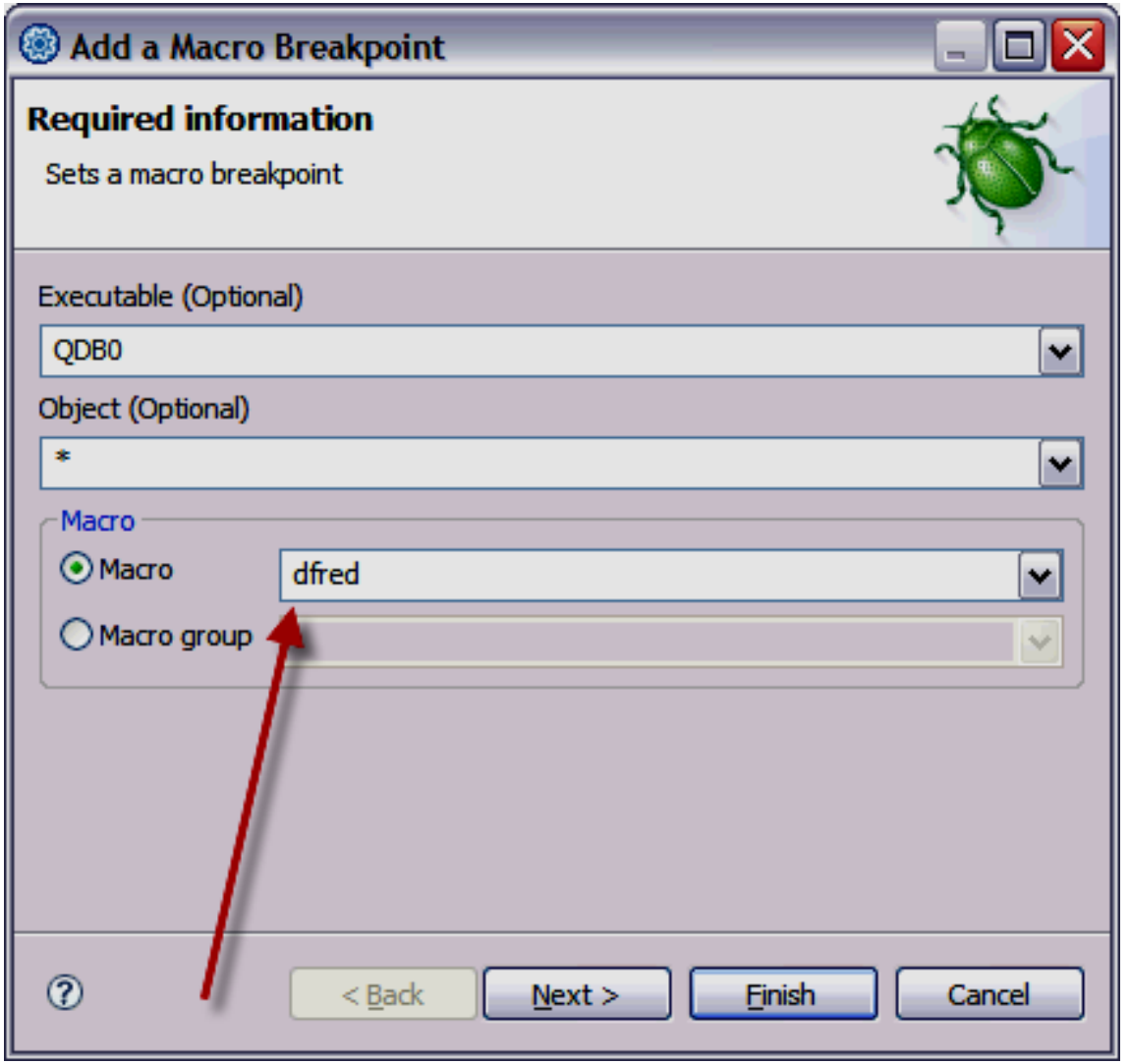
TPFDF Macro Breakpoints

- **TPFDF Macro Names can now be entered through the Macro Breakpoint pane.**



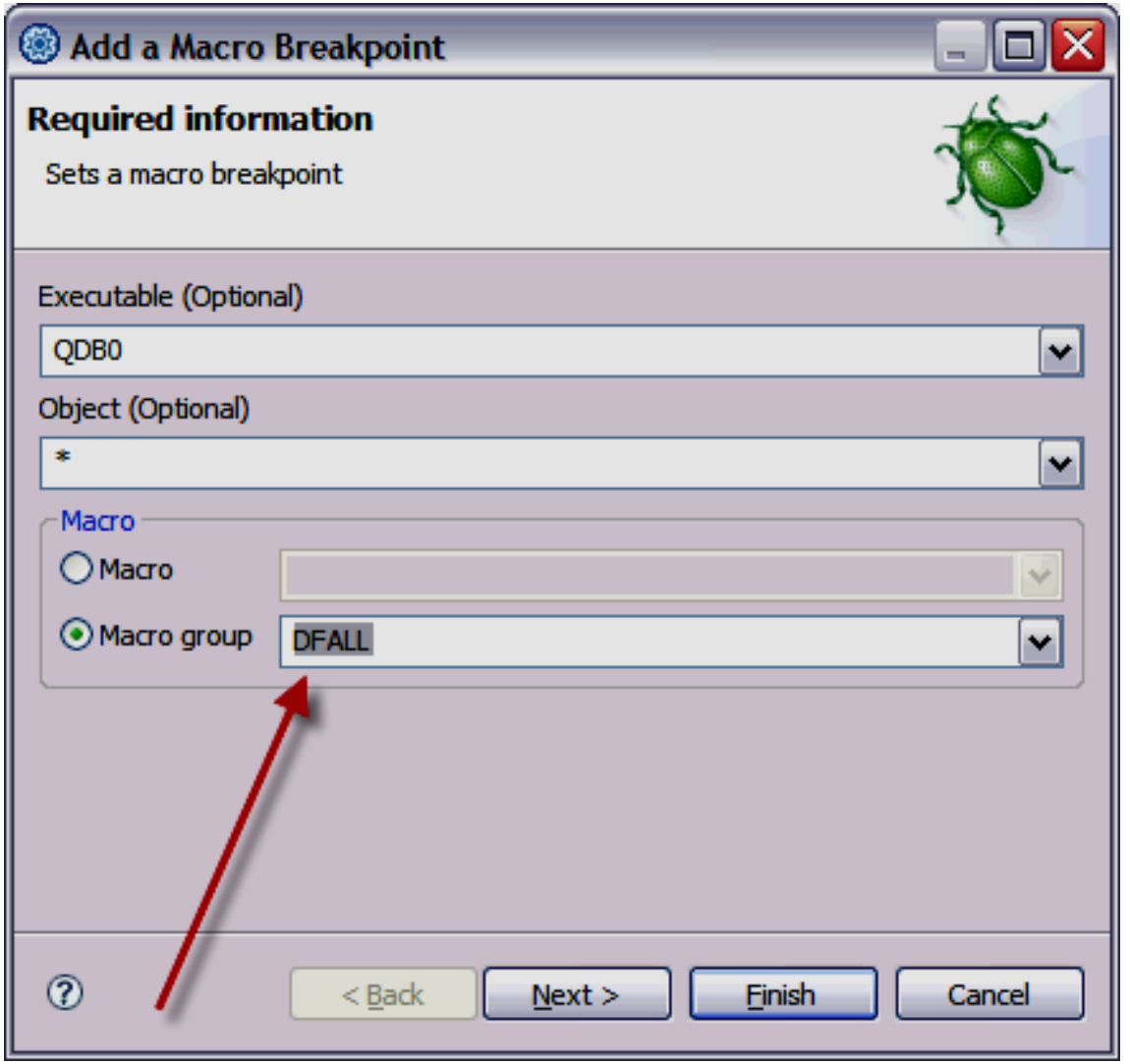
TPFDF Macro Breakpoints

- **TPFDF C/C++ Macro equivalents can now be entered through the Macro Breakpoint pane (ie. dfred, dfopn, etc).**



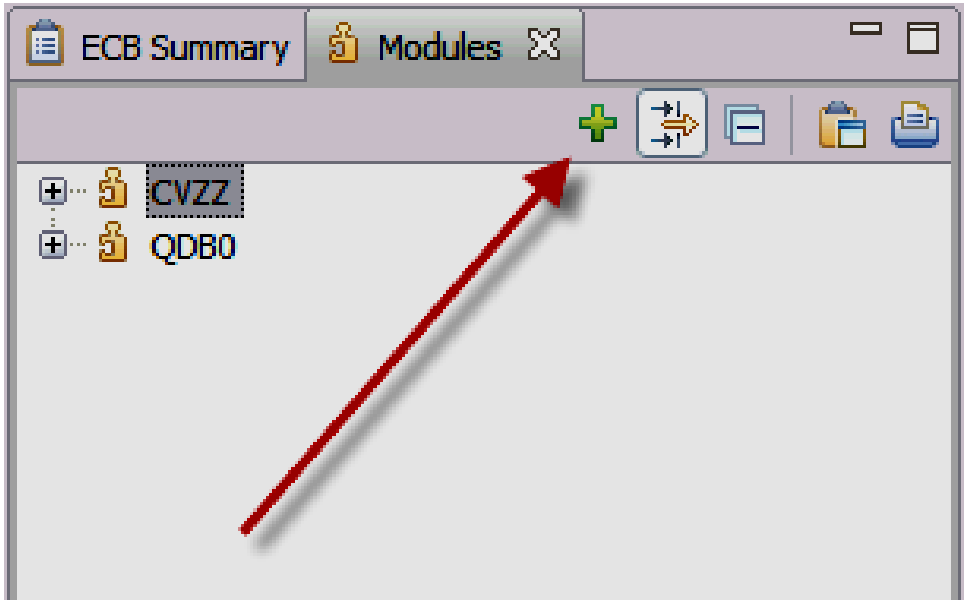
DFALL TPFDF Macro Group

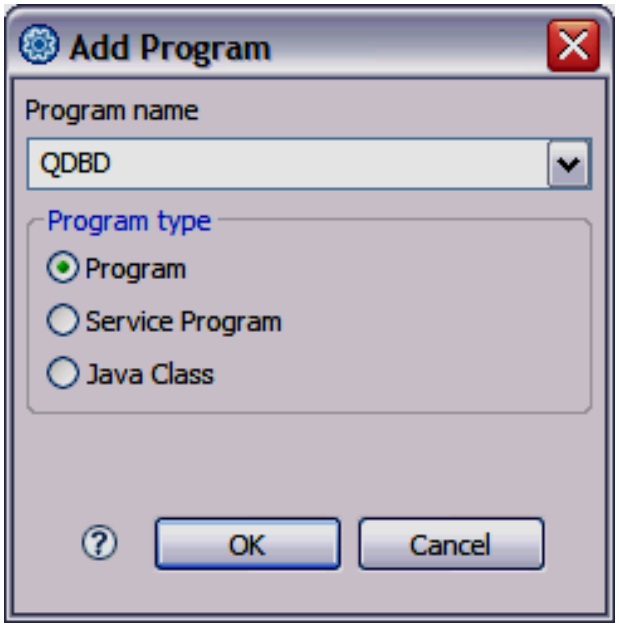
- **The DFALL Macro Group will stop the application when any TPFDF Macro or C/C++ Macro equivalents is executed by the application.**



Add Module (Add Breakpoint in any Module)

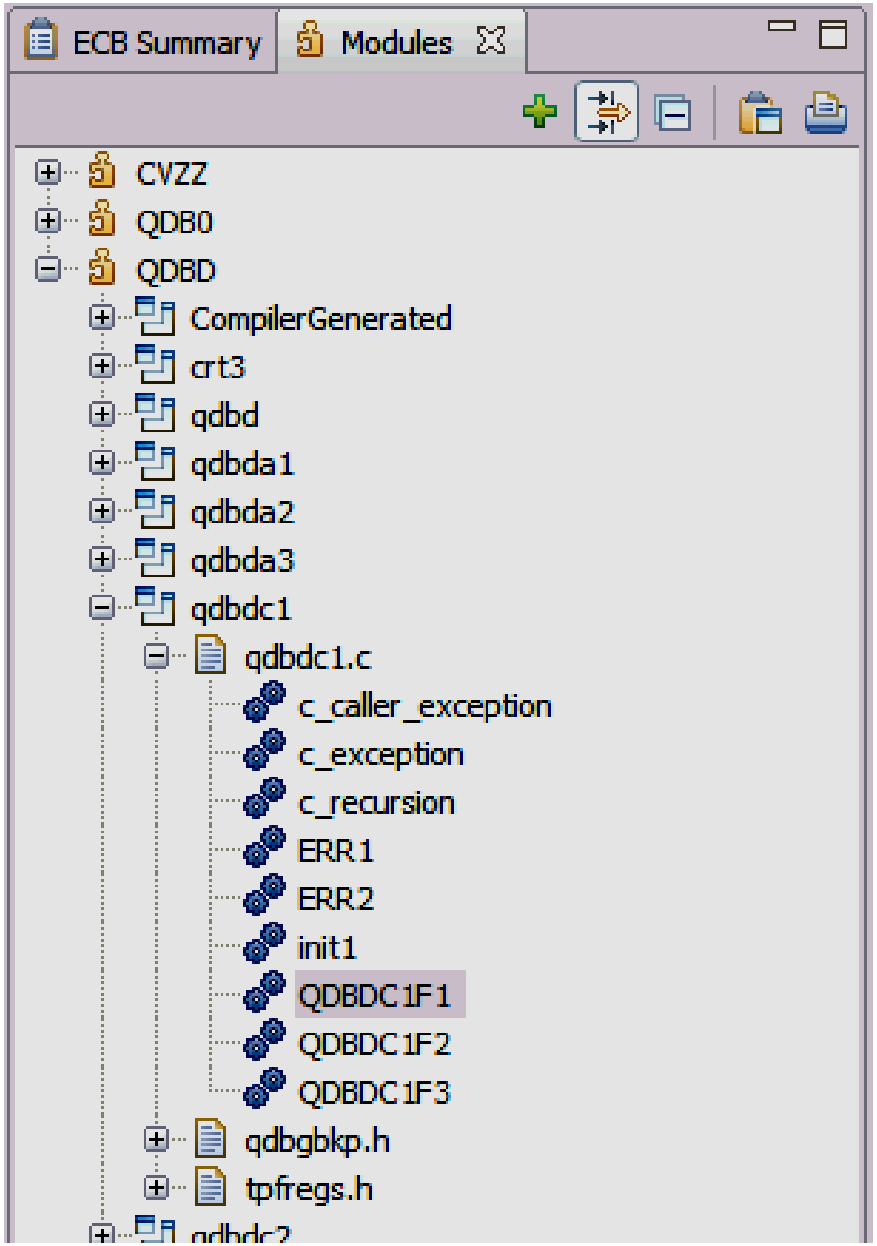
- **Add Module allows the user to make the debugger aware of a module that has not been debugged or appeared on the stack.**
- **From the Modules view, you can now choose the Green Plus (Add program to debug). From the Add Program dialog, enter the 4 character program name and choose OK.**
- **The debugger will attempt to get debug information for the specified module and allow you to perform a variety of actions**





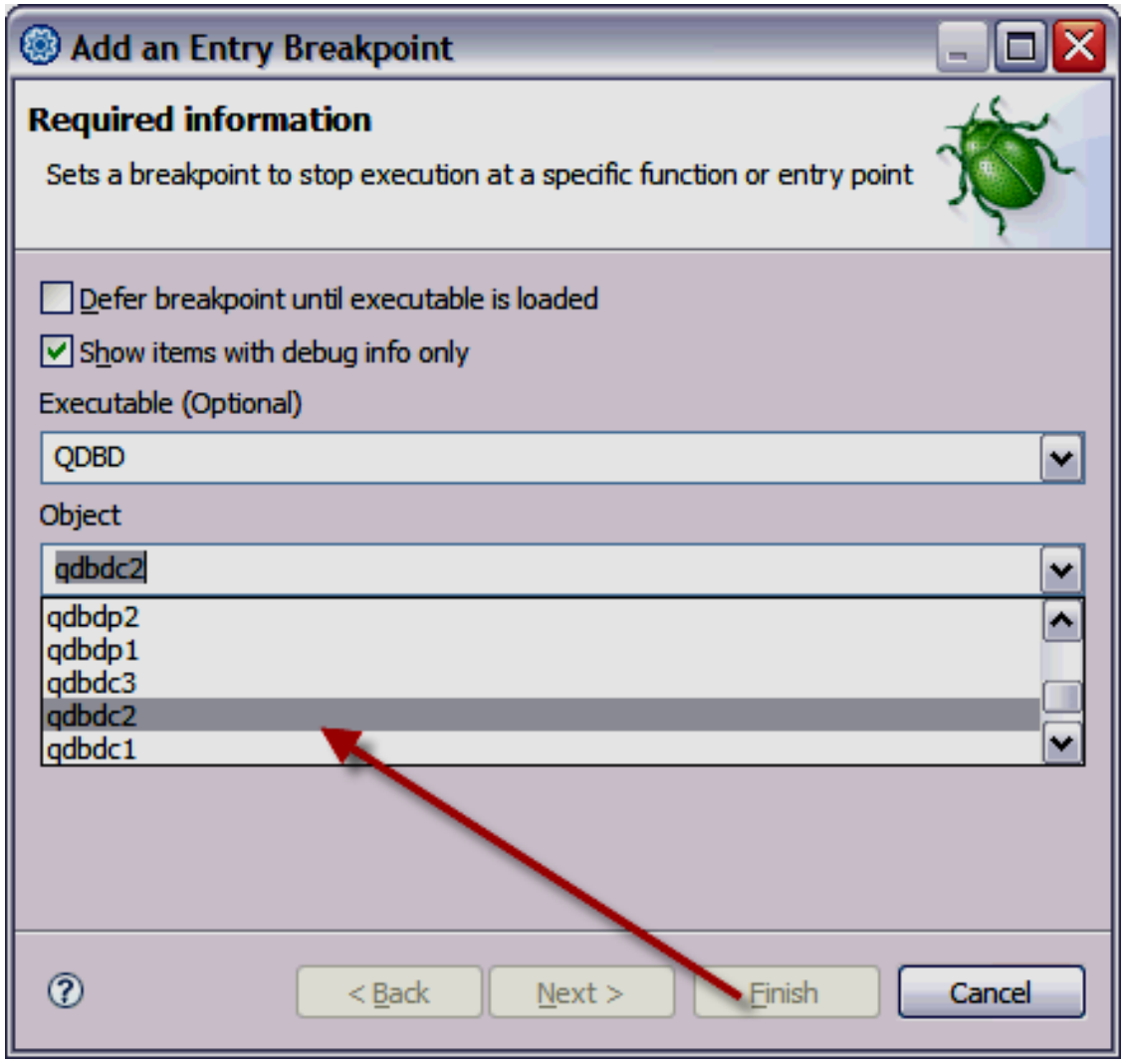
Add Module (Add Breakpoint in any Module)

- **Available actions in the Modules view**
  - See all objects in a Module
  - See all files compiled to create an object
  - See all functions in a file
  - Open the file with a double click on the file or function (then set line/address breakpoints from a double click in the source)
  - Right function to set function breakpoints



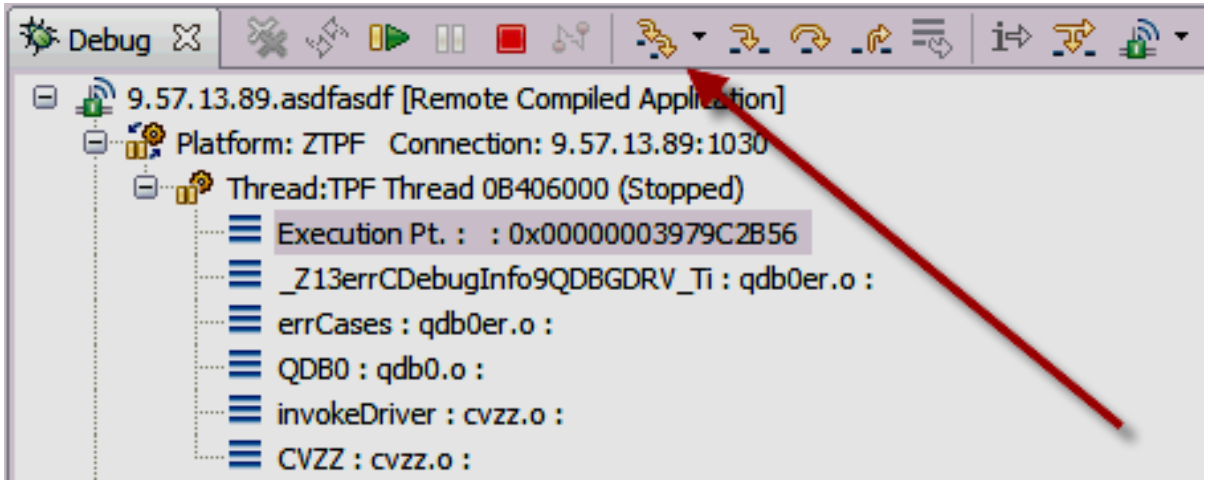
Add Module (Add Breakpoint in any Module)

- **Actions available from the breakpoints view**
  - When adding a breakpoint, the executable, objects, and functions will be available from the drop down lists for the added module.



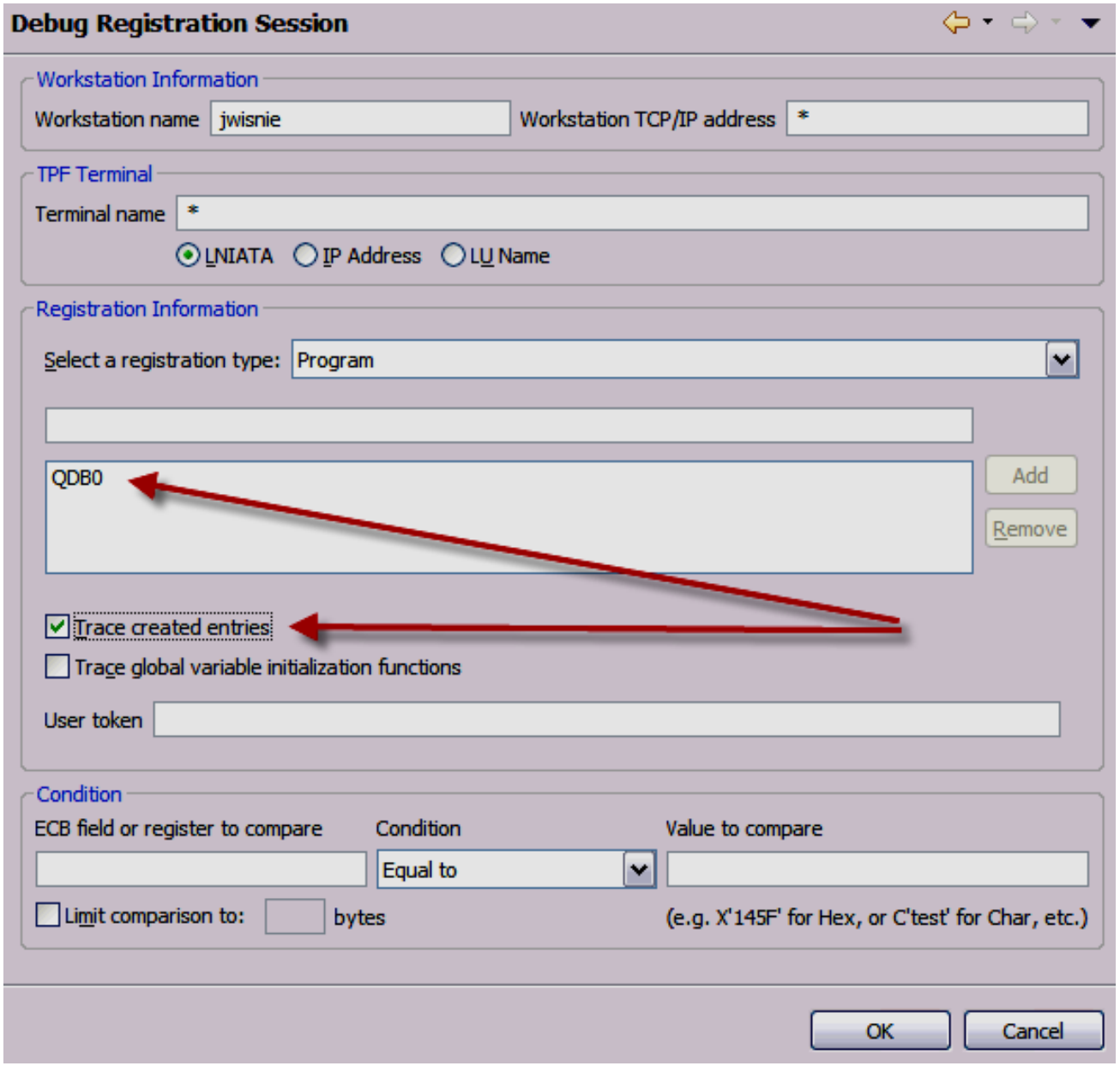
Auto-Stepping (Trace Run Slow)

- **Click the “Animated Step Into” button to set the debugger automatically doing a step into at the specified time interval.**
- **Click the “Animated Step Into” or another execute (Resume, step into, etc) button to deactivate this feature.**
- **From the drop down to the right of the “Animated Step Into” button, you can modify the preferences.**



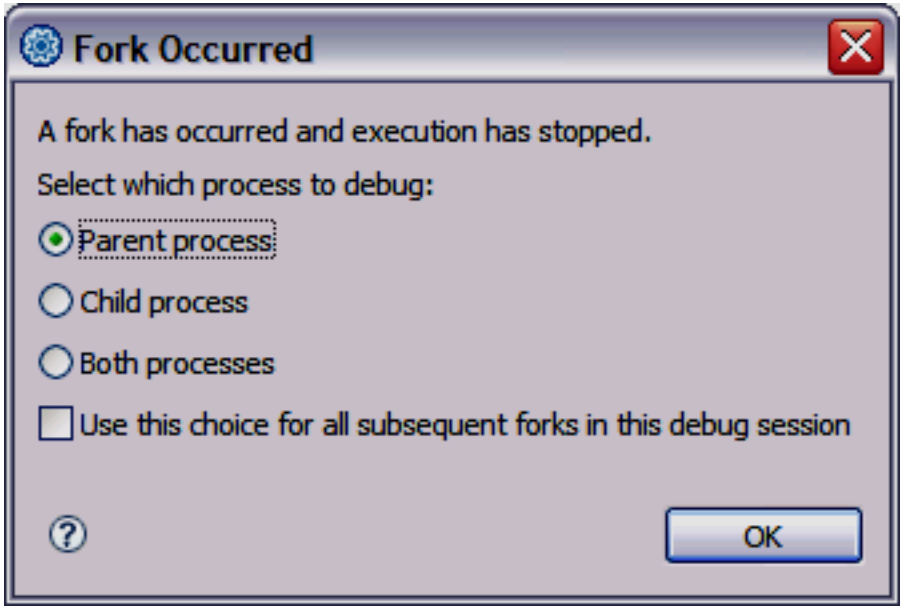
Enhanced Fork Support

- **“Trace created entries” must be checked.**
- **Register only the Parent program (Child program does not need to be registered any longer)**
- **Fork is generic term for CREMC, CREDC, SWISC create, TPF_fork, etc.**



Enhanced Fork Support

- **Three options available when a fork event occurs:**
  - Parent Process: Means ignore the fork event. The Parent continues the previous execute request (step into, run, etc).
  - Child Process: Means create a new debugger session for the Child process. The Parent continues the previous execute request (step into, run, etc).
  - Both Processes: Means create a new debugger session for the Child process. The Parent process stops at the next executable line in debuggable code.



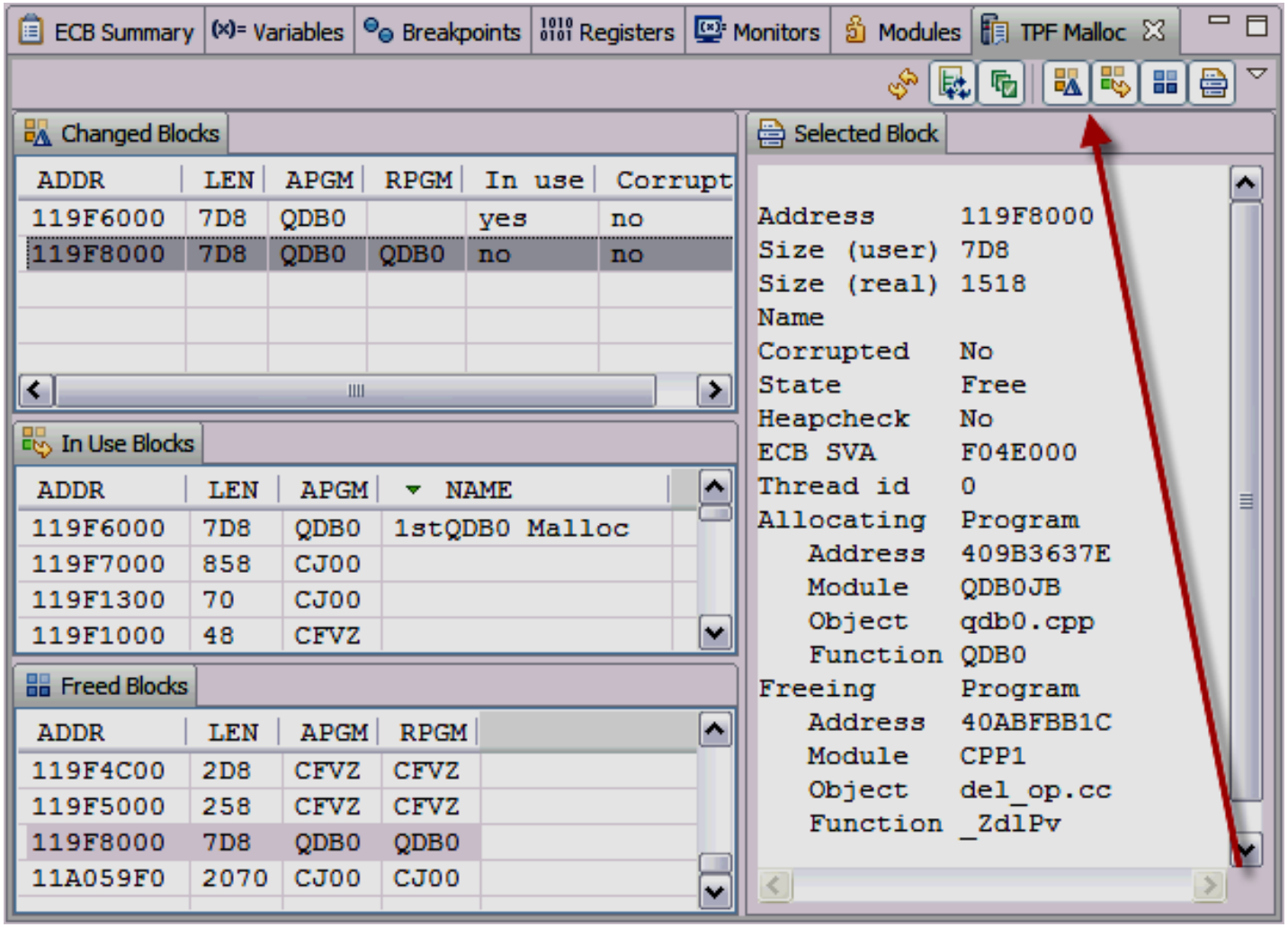
Enhanced Fork Support

- **When the “Fork Occurred” dialog appears, the Debug Console now shows a message indicating where the fork type event occurred and what program the created ECB will enter.**

```
DBUG8158I Module QDB0 issued a tpf_fork() to QDBM
in object qdb0go.o, offset 0x1B6, function goCases
```

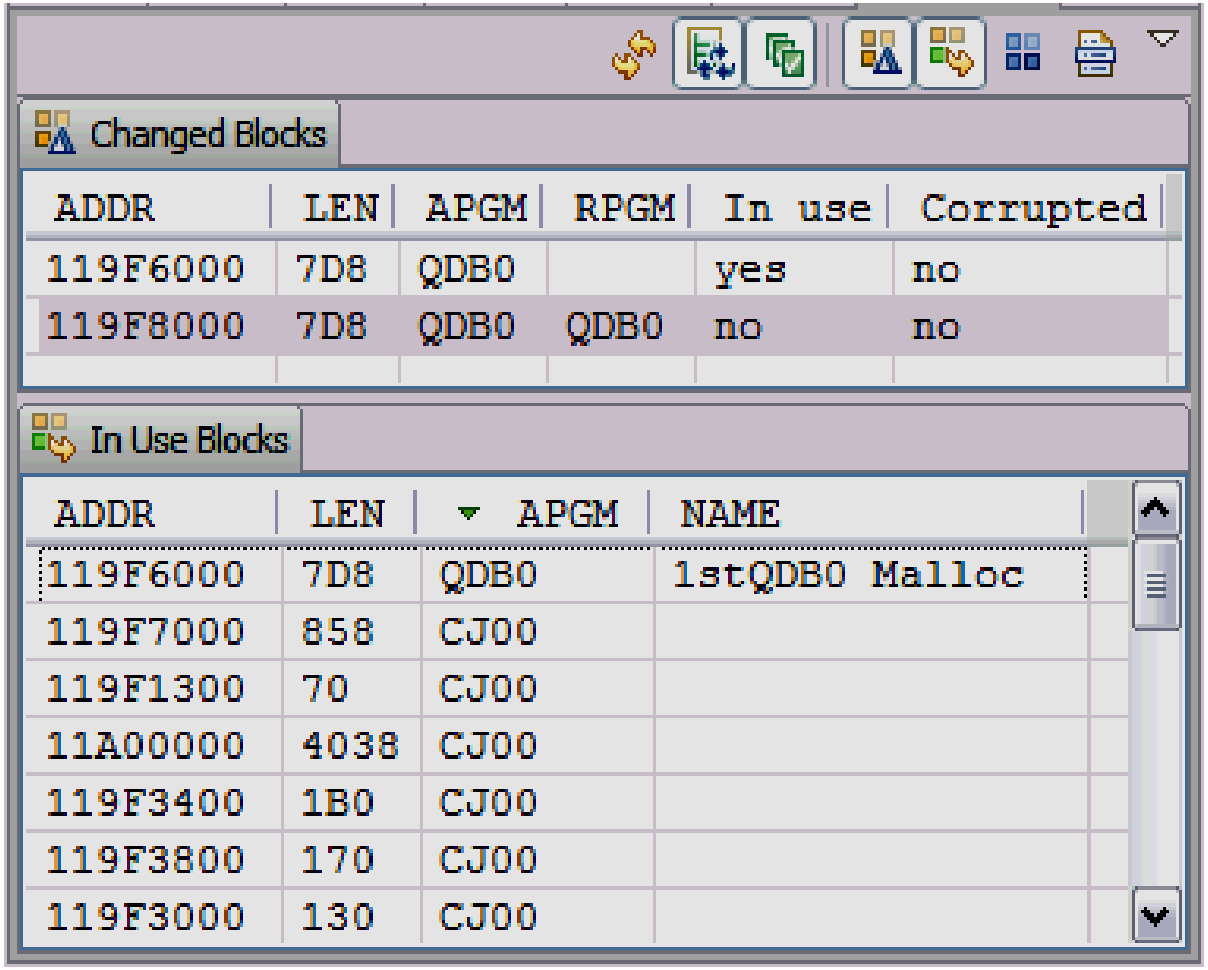
Malloc View

- **The malloc view is made up of 4 panes which can be individually hidden by the buttons in the upper right corner of the view.**



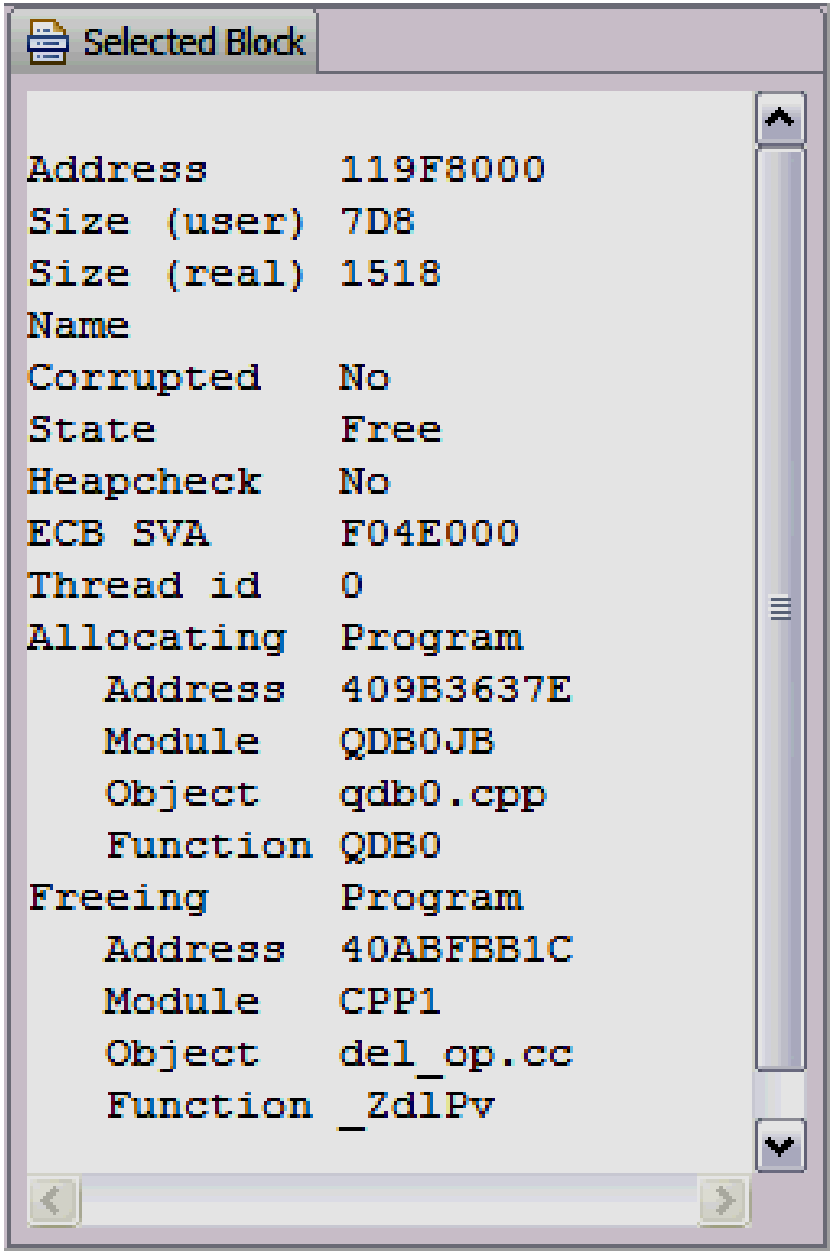
Malloc View

- **The inuse and free panes shows the malloc blocks that are inuse or free respectively**
- **The changed panes show the changes in malloc since the last refresh**



Malloc View

- **The selected block pane shows additional information about a malloc block that is selected in one of the other panes such as the program that did the malloc or free.**

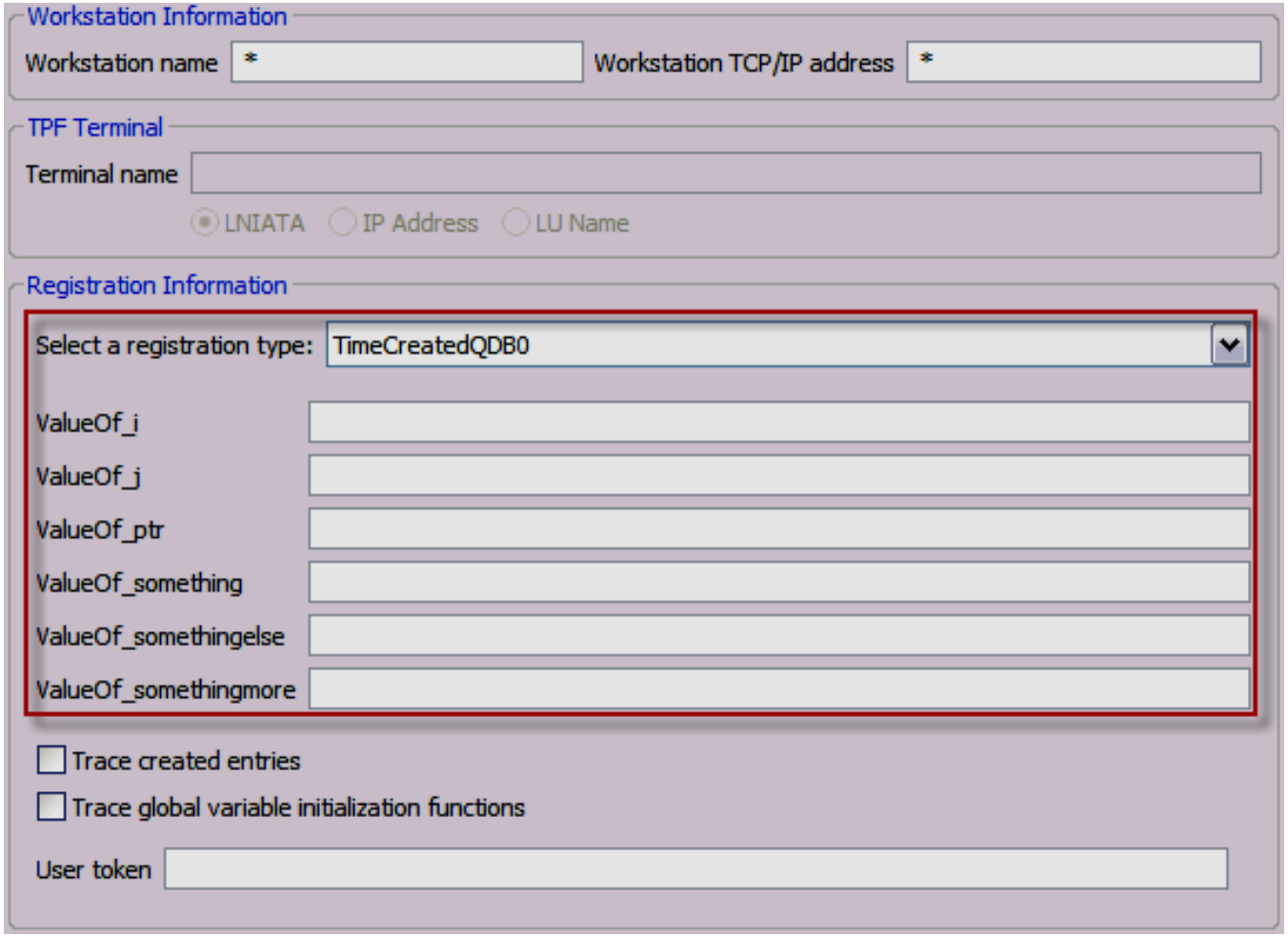


Malloc View

- **The malloc view provides corruption detection if the corrupt column is visible in any pane. If corruption is being detected, the corrupt blocks will always show in the changed pane.**
- **The malloc view can refresh automatically on each step or set to only refresh when the refresh button is pressed.**
- **The user can also do actions like “go to address” to view the malloc block in the memory view.**
- **Columns can be rearranged, sorted, and hidden.**
- **Names for named malloc entries can also be shown and sorted.**

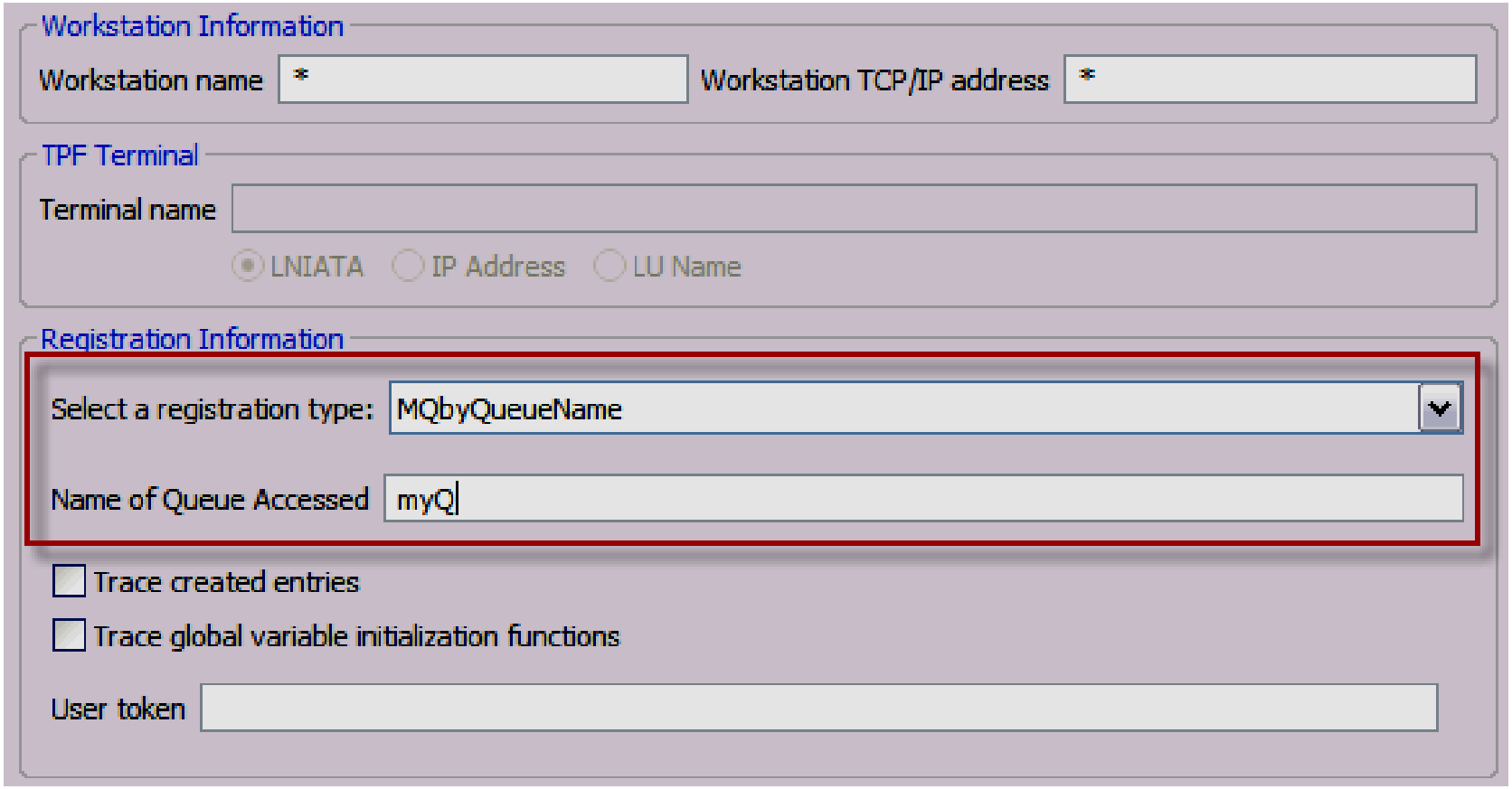
Register by User Defined (Transaction Trapping)

- **This feature allows you to start the debugger virtually anywhere based on conditions that you specify.**
- **Examples of types of registration:**
  - **Start a debugger session for a time created ECB based on the internal variable values that are of interest.**



Register by User Defined (Transaction Trapping)

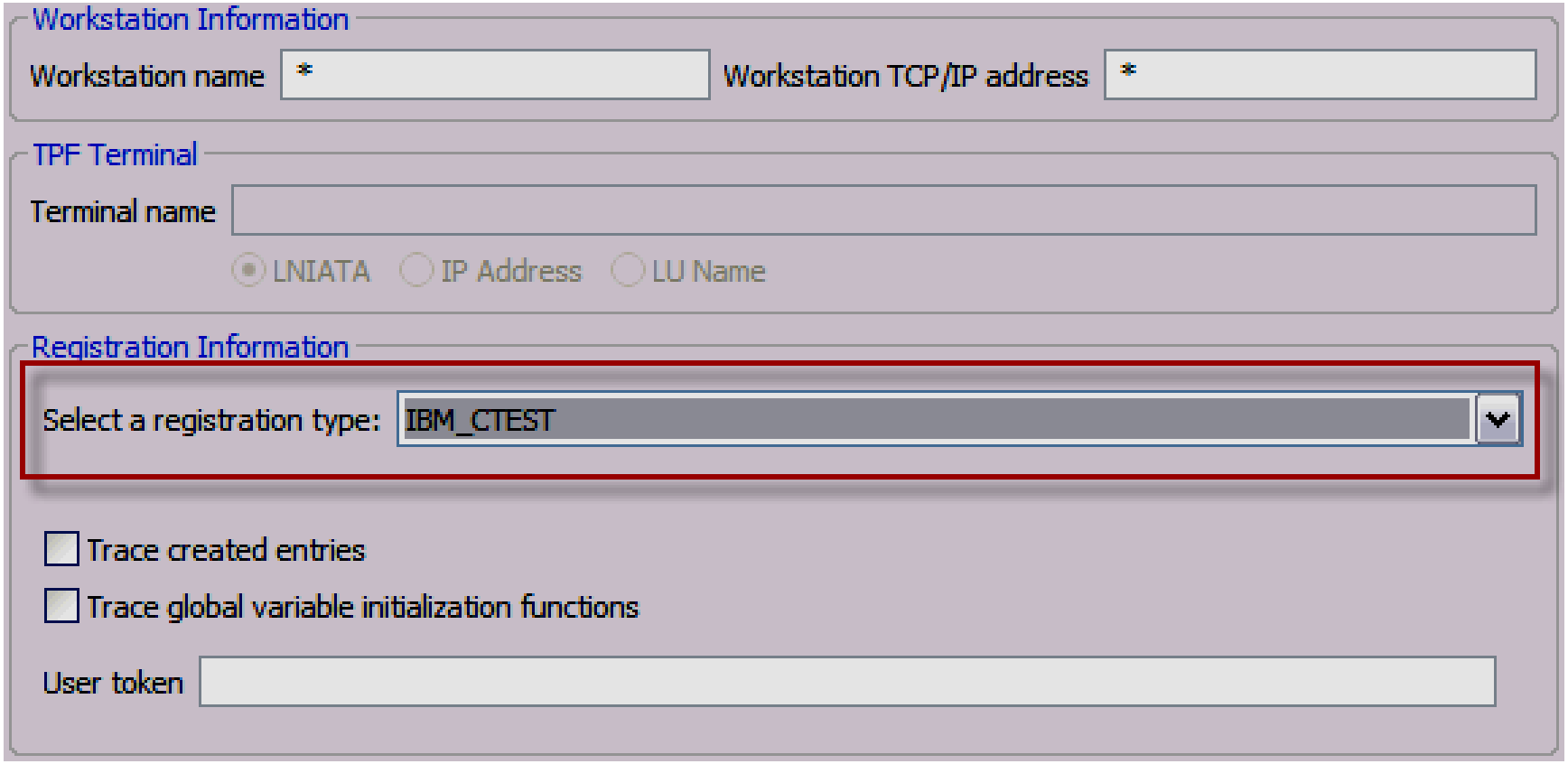
- Start a Debugger session for an ECB when it accesses a registered MQ queue by name.



- See Appendix A for more information

Register by User Defined (Transaction Trapping)

- CTEST now uses the User Defined Registration support. Code ctest() in your application and then register with the new IBM_CTEST registration type.



Trace Log Enhancement

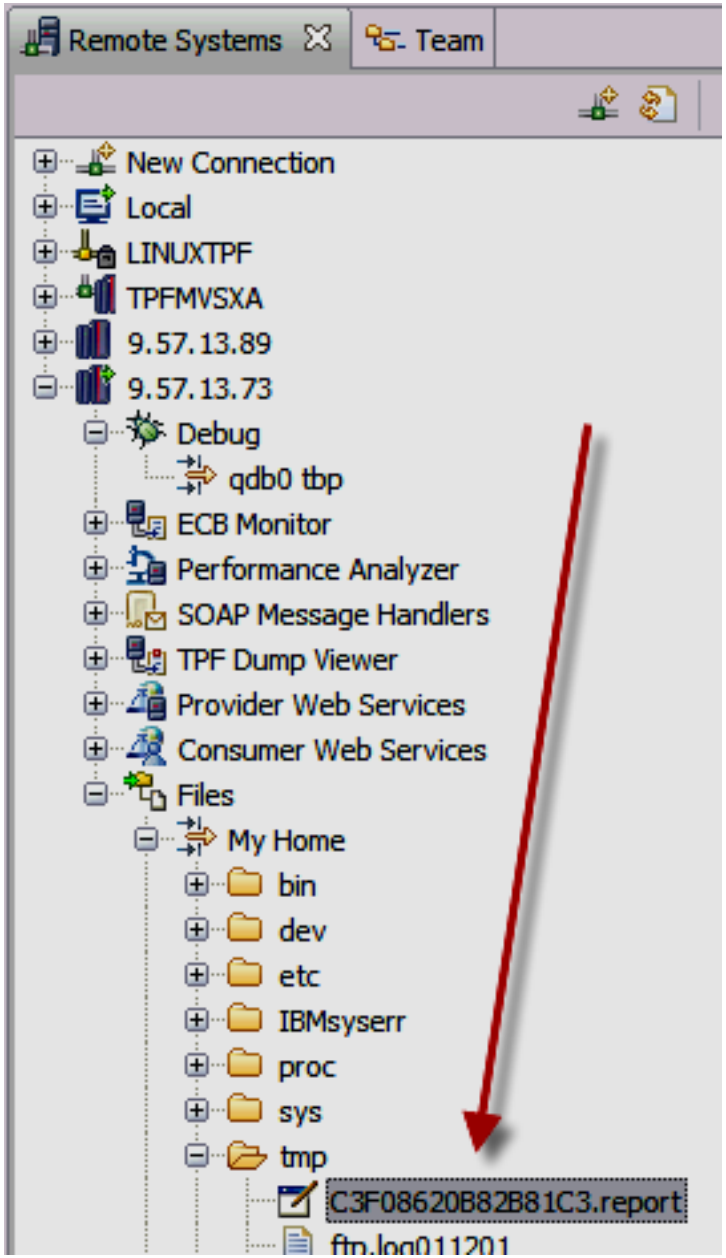
- **Currently, the TRLOG debugger command that is entered through the debug console can only produce a binary format trace log file on the TPF file system. This file must then be post processed offline on Linux.**
- **A new TRLOG parameter has been provided to produce the trace log file in text format with the extension .report such that post processing is not required.**

  TRLOG PROC-/directory

- **The .report files can then be opened in LPEX through the TPF Files Subsystem. LPEX provides advanced searching mechanisms.**

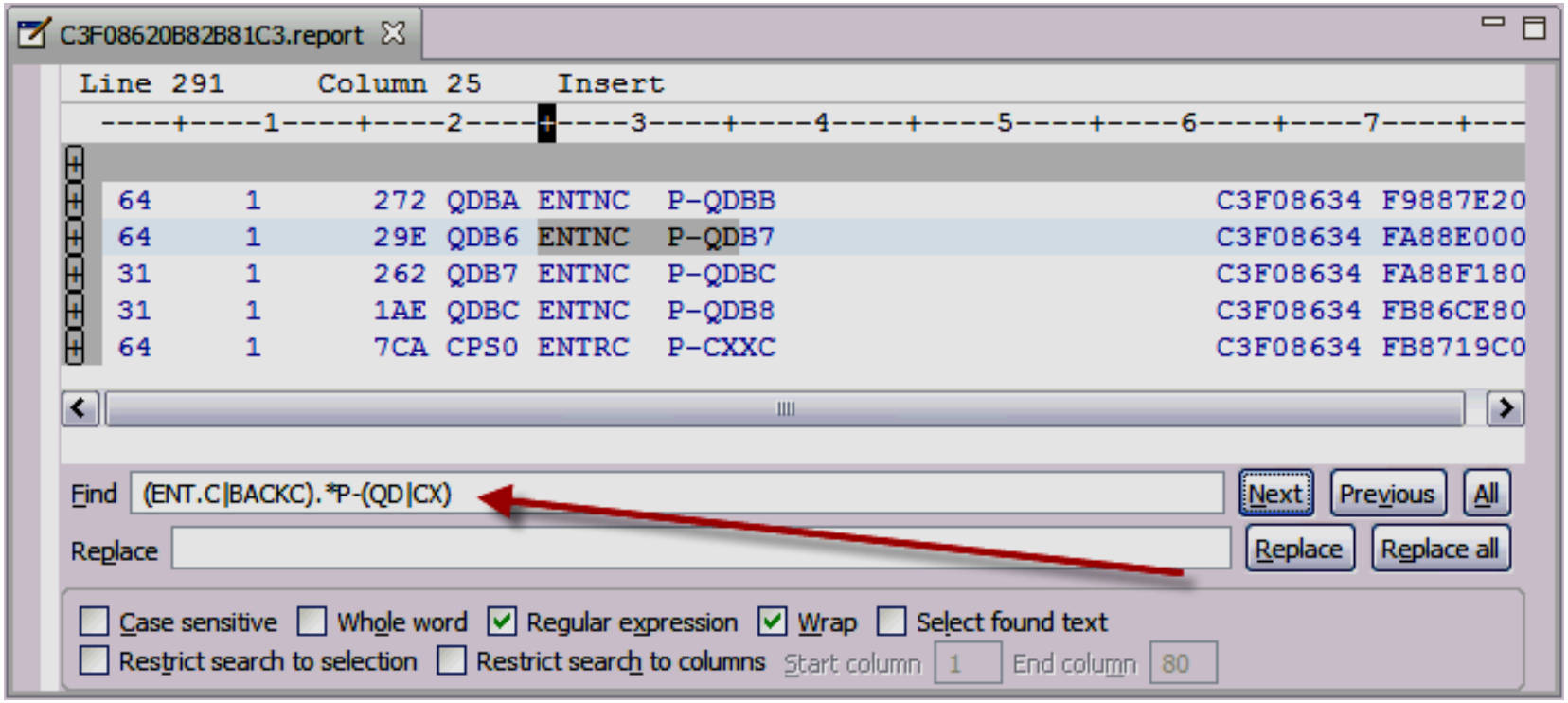
Trace Log Enhancement

- **The Files subsystem is essentially a GUI FTP client. Double clicking the file will open the file in LPEX.**



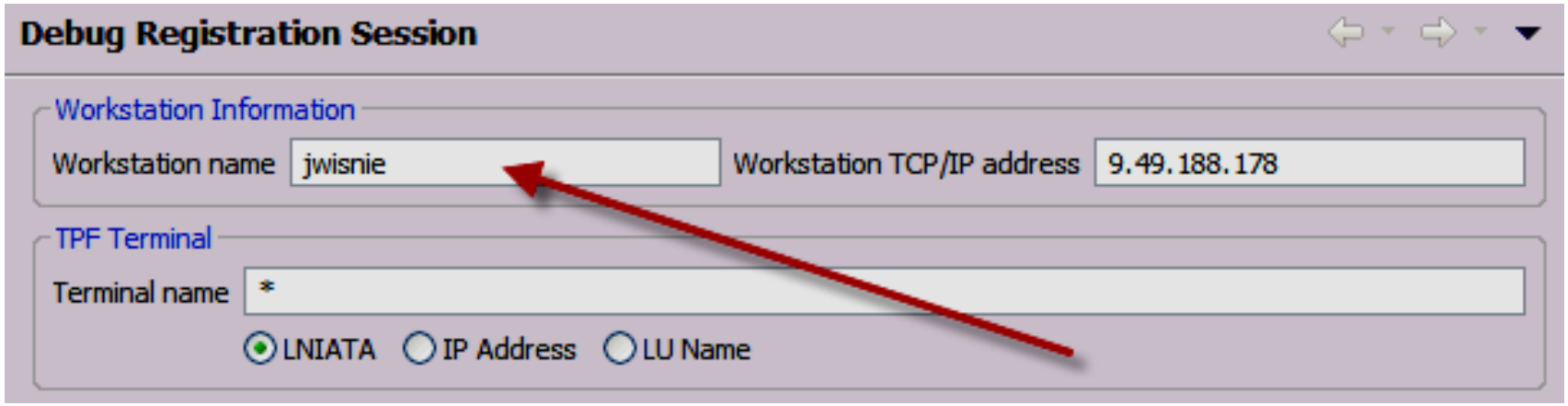
Trace Log Enhancement

- **Execute the desired searches through LPEX (regular expressions are supported, the regular expression below locates all ENTER and BACKC macro calls for the packages named with QD* and CX*)**



Diagnostic Enhancements

1. **Registration now includes the workstation name. If the specified IP address fails, DNS will be queried for an IP address to use. However, VPN clients that generate workstation names will still fail to connect. If * is entered for the workstation name or IP address, the workstation name and IP address will automatically be detected.**



Diagnostic Enhancements

2. **Re-registering a debug session with a different IP address will now replace any existing registration entry for the same debug session based upon the matching workstation name.**
3. **If a registration entry is made and other registration entries exist on TPF with the same workstation name but having different workstation IP addresses, the existing registration entries will be updated with the newest IP address.**
4. **User's can set the connection timeout which is now set to a default of 3 seconds.**
5. **The originating terminal is now copied to EBROUT of the debugger ECB such that the debugger will issue a WTOPC to the originating terminal for any COMMS errors.**
6. **The GLUE block and workstation name are now included in dumps such that operators/administrators can follow up with the developer.**

Debugger with Heap Check mode

- **TPF recommends that your z/TPF test systems are run with Heap Check mode on.**
- **Previously, it was not recommended to have Heap Check mode on when using the Debugger.**
- **This recommendation has now been reversed and the Debugger can be run with Heap Check mode on without any affect on the debugger (Heap Check mode is always turned off for the Debugger regardless of the system setting).**

CDBPUX User Exit

- **On TPF 4.1, the Debug listener would never be running in a production environment which prevented debugger sessions from being started in a production environment.**
- **On z/TPF, Web Services requires the Debug listener to be running in a production environment.**
- **The Debugger registration code has been updated to turn on the system hooks when a debugger registration entry is created instead of when the debug listener is started.**
- **The CDBPUX User Exit provides you the flexibility to allow or prevent registration traffic of your choosing on a given system (for example you could allow dump viewer sessions but prevent all debugger registrations except for a specific IP, User Token or etc).**
- **The CDBPUX User Exit should be used on production systems to prevent debugger registration (running ECBs should not be debugged/stopped on a production system). However, other debugger features such as the dump viewer and ECB monitor can be used on a production system.**
- **See cdbpux.c for more information.**

Other new features to check out

- **Dump Capture User Exit – capture and display user specified data in the dump viewer and ECB monitor**
- **Event Breakpoints – Stop at specific C/C++ exceptions with the XCPTRap command or debug all caught exceptions, uncaught exceptions, or system errors.**
- **XML Generator for ASM DSECTs – Automatically generate XML maps with maketpf builds for use in the memory, SW00SR, or other views.**

z/TPF Debugger Deliverable Details

Description	z/TPF APAR	TPF Toolkit Level	TPFUG Requirement
Register by Function Register by System Error System Error Retry	PJ34615 PUT6	V3.4.0	 V08058S
Remote Debug Info ECB Summary View Add Macro Breakpoint	PJ35430 PUT6	V3.4.2	V08061S V08029S
ALLSVC Macro Group	PJ33189 PUT5	None	V08057S
TPFDF Macro Breakpoints DFALL TPFDF Macro Group	PJ35669 PUT6	None	V08055S

z/TPF Debugger Deliverable Details

Description	z/TPF APAR	TPF Toolkit Level	TPFUG Requirement
Add Module (add breakpoint in any module)	PJ35059 PUT6	V3.2.x	V08062S
Auto-Stepping (trace run slow)	None	V3.4.0	V07009F V08045F
Enhanced Fork Support	PJ34894 PUT6	None	V08030S
Malloc View Register by User Define (transaction trapping) Trace Log Enhancement Diagnostic Enhancement Macro Group List	PJ36059 PUT6	V3.4.3	V08036F V08031S V07008F V08001S V08008S V07013F V08002S V08015S

z/TPF Debugger Deliverable Details

Description	z/TPF APAR	TPF Toolkit Level	TPFUG Requirement
Debugger with heap check mode	PJ34800 PUT6	None	
Dump Capture User Exit	PJ34228 PUT5	None	
CDBPUX User Exit	PJ32209 PJ34474 PUT5	None	
Event Breakpoints	PJ32719 PUT5	None	
XML Generator for ASM DSECTs	PJ31440 PUT5	None	

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Appendix A: Register by User Defined

- **How is register by user defined setup by an administrator?**
  1. An XML file on the workstation defines the registration type and parameters that a user would register
  2. Code a user exit function or 4 character program to evaluate the registered conditions
  3. Add a call to the application code to the registration handler.
     - Performance sensitive macros are provided such that this code can be left in production code but avoid the registration handler code and have minimal effect on performance.
     - Assembler and C/C++ interfaces provided.
     - See the source segments c_udrt.h, udrpc.mac, iudrt.mac, cudrt.c and cdbx.c for more information and examples. Or search the TPF Toolkit help for the topic “custom defined registration”.
- **The following slides show an example of a user defined registration for a time initiated application QDB0 based on internal variable values.**

Appendix A: Register by User Defined

1. **Modify the file <TPF Toolkit install dir>\Config\ TPFSHARE\Debug Registration/ customDebugRegTypes.xml**
   - Ids 101-255 are for customer use (0-100 are reserved for IBM)
   - Specify the registration name and up to 6 parameter names
2. **Restart the TPF Toolkit**

```
<customRegistration>
    <id>101</id>
    <name>MQByQueueName</name>
    <parameter>Name of Queue Accessed</parameter>
</customRegistration>
<customRegistration>
    <id>102</id>
    <name>TimeCreatedQDB0</name>
    <parameter>ValueOf_i</parameter>
    <parameter>ValueOf_j</parameter>
    <parameter>ValueOf_ptr</parameter>
    <parameter>ValueOf_something</parameter>
    <parameter>ValueOf_something_else</parameter>
    <parameter>ValueOf_something_more</parameter>
</customRegistration>
```

Appendix A: Register by User Defined

3. Implement the resolving function to test application state against the user registered values

```
unsigned int CDBX_TimeCreatedQDBOCheck(struct tpf_UserDefRegTypStruct* ptr, struct itbpentry* reg)
{
    unsigned rc = FALSE; //set default return to false

    switch(ptr->udrt_id)
    {
      case 102:
      {
              //verify that i matches
              if(*((unsigned int *)ptr->udrt_parm1) != atoi((char*)reg->itbp_udrt_parmValue[0]))
                      break; //no, we're done
              //verify that j matches
              if(*((unsigned int *)ptr->udrt_parm2) != atoi((char*)reg->itbp_udrt_parmValue[1]))
                      break; //no, we're done
              //verify that ptr matches
              if(strcmp((char*)ptr->udrt_parm3,(char*)reg->itbp_udrt_parmValue[2]) != 0)
                      break; //no, we're done

              //passed all tests, start the debugger
              rc = TRUE;
              break;
      }
      case 103:
      //...
      default:
              break;
    }
    return rc;
}
```

Appendix A: Register by User Defined

4. **Update the application code to call User Defined Registration handler, passing in the resolving function to use.**

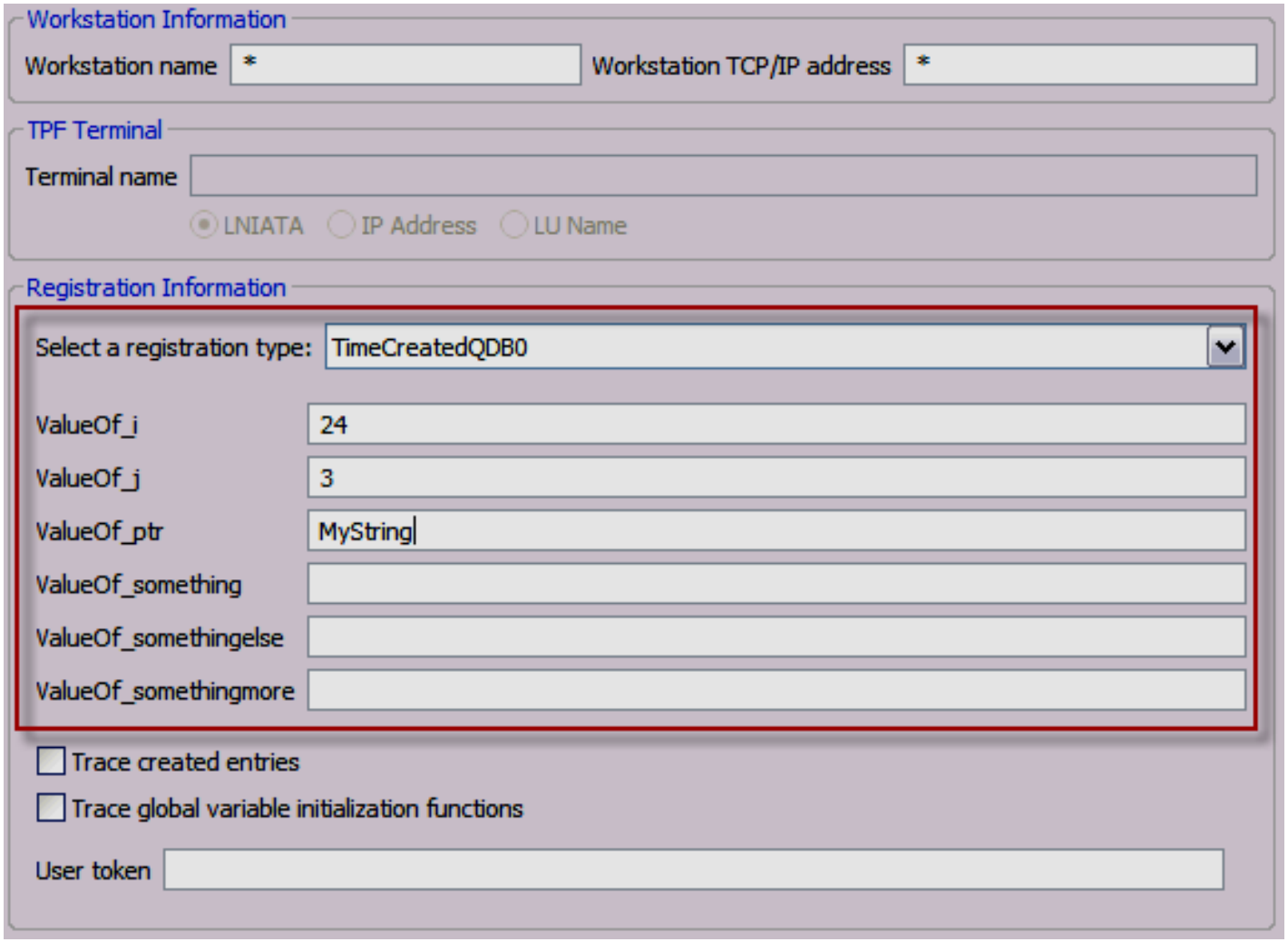
qdb0.cpp

```
char                    * sys_state = (char *) cinfc_fast(CINFC_CMMSTI);

if(tpf_UserDefRegTypPerfCheck(102))
{
    struct tpf_UserDefRegTypStruct temp = {0};
    temp.udrt_id = 102;
    temp.udrt_funcptr = (tpf_UserDefRegTypUserExit *)CDBX_TimeCreatedQDB0Check;
    temp.udrt_parm1 = (void*)&i;
    temp.udrt_parm2 = (void*)&j;
    temp.udrt_parm3 = ptr;
    tpf_UserDefRegTypHandler(&temp);
}
```

Appendix A: Register by User Defined

5. **Register the debugger with the conditions to start the debugger on the application**



Appendix A: Register by User Defined

6. **Start the application to be debugged.**
7. **When the application is started, the tpf_UserDefRegTypHandler function will call the resolving function passed to it, to test the application state against each registration entry of the same type.**
8. **If the resolving function returns TRUE, the Debugger will start at the next executable line of debuggable code.**