Using DDT

Debugging programs with DDT

Peter Towers

HPC Systems Section

Peter.Towers@ecmwf.int



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Allinea DDT

- DDT is a very popular interactive debugger
 - Developed by Allinea Software in the UK
 - Modern graphical user interface
 - Highly scalable to large numbers of tasks/threads
- Cray provide a 2048 task licence
 - No limit to threads per task
 - Support from Cray backed up by Allinea
- Version 4.2.1 installed
 - Cray have not yet released version 5 (Allinea Forge)
- Also available on the latest ECMWF desktops
 - Uses the same licence



DDT Features

- Examine sources
- Set breakpoints
 - Pause at a line of source
 - Conditional breakpoints supported
- Examine variables, Fortran modules, stack
- Set tracepoints
 - Output values of variables at a line without pausing
- Set watchpoints
 - Pause when a variable changes value



DDT Features

Step through execution line by line

- Step to the next line or into a function
- Step over a line
- Step out of a function
- Catch signals
 - Segmentation violations
 - Floating point exceptions
- Track and debug memory usage
 - Record all memory allocations
 - Find memory overwrites
- Examine message queues

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Compilation

- DDT uses the GNU Debugger (GDB) under the covers
- Compile with symbolic debug information turned on
- With CCE use

-g for debug info and no optimisation

-G1 or -G2 for debug info with optimisation

With Intel use

-g for debug info



Launching DDT in batch

export DISPLAY=<your workstation>:0.0

module load ddt

ddt –n ? –mpiargs 'more aprun args' a.out

For example

ddt -n 4 -mpiargs '-N 4 -ss -cc cpu -d 6' a.out



Simple Job Script

#!/bin/ksh
#PBS -q np
#PBS -N ddtdemo
#PBS -j oe
#PBS -o job.out
#PBS -I EC_total_tasks=4
#PBS -I EC_threads_per_task=6
#PBS -I EC_hyperthreads=1
#PBS -I walltime=00:60:00

cd \$HOME/Debug

module load ddt

export DISPLAY=juliet:0.0

export OMP_NUM_THREADS=6

ddt -n 4 -mpiargs '-ss -cc cpu -N 4 -d 6' ./hello_mpi



Live Demo Using IFS

- TL159 running on 1 node
 - Initially with 4 tasks x 6 threads
 - Then with 24 tasks x 1 thread
- Latest RAPS14 benchmark code (CY41R2)
- Run in batch
- Selected screen shots from DDT follow in the presentation material
- Now for the live demo.....



Before launching executable

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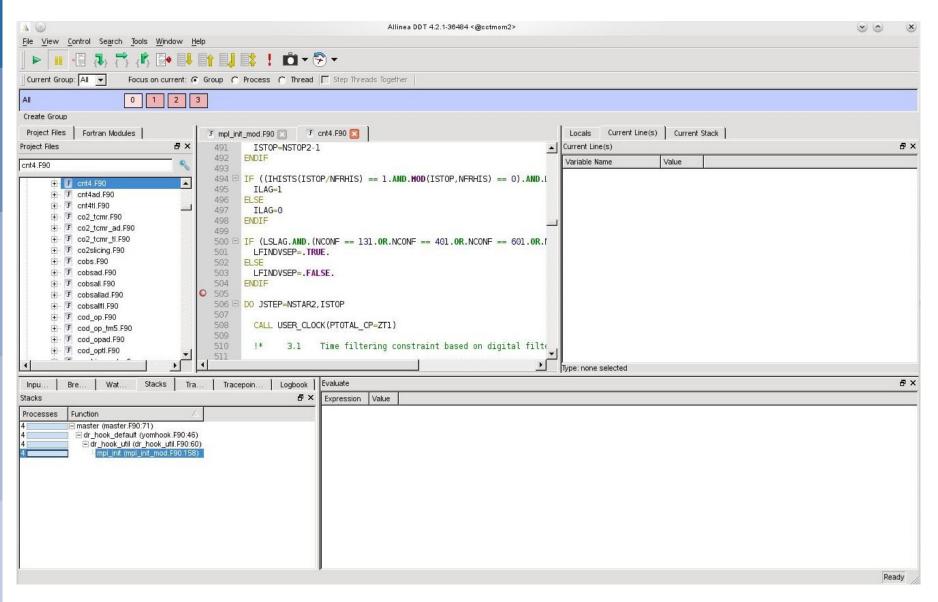


Paused after MPI_INIT

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⊕ F mpl_gatherv_mod.F90 163	
F mpl_groups.F90 I64	
166 If (CL ARCH(1:10) == 'ibm power4') then	
E mpl joint mod E90 167 ! write(0,*)'POWER5: CALLING EC_BIND AFTER MPI_INIT'	
□ I mp_ocomm_create_mod.F90 I 168 CALL EC_BIND() □ I mp_locomm_create_mod.F90 I 169 endif	
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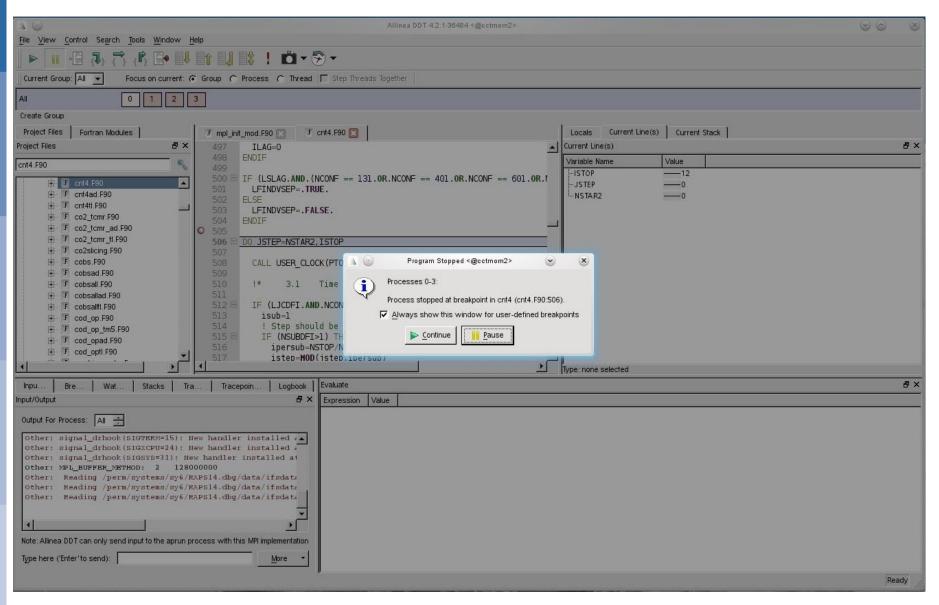


After selecting cnt4.F90 and setting a breakpoint at line 505



CECMWF

Hitting the breakpoint



CECMWF

At the breakpoint

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Setting a trace point at line 511 for JSTEP and ZT1 every 3rd step

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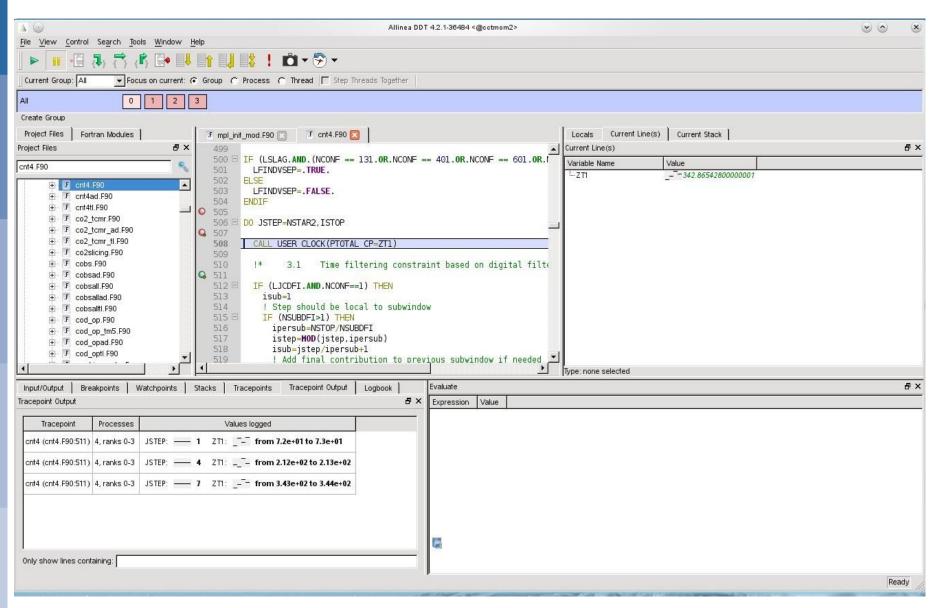
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Setting a conditional breakpoint at line 507 for step 8

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Trace point output after 8 steps





Running a 24 x 1 configuration

- IFS runs until it gets a Floating Point Exception
- Caused by a divide by zero
- The physics time slice has gone to zero
- Will use a watch point to find out where



Hitting the divide by zero

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aprun: 11:36:20 STEP 2 H= 2:00 +CPU= 5.812		
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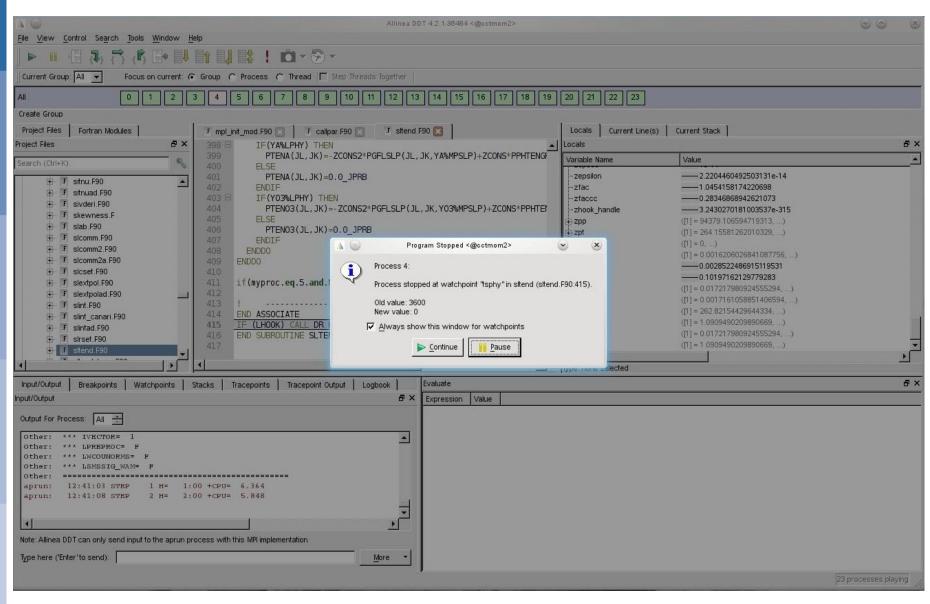
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After reaching a breakpoint in callpar.F90 and setting a watch point on tsphy

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After the watch point triggers in sltend.F90





Line 411 did it!

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+ F sivderi.F90 404 PTEN03(JL, JK)	=-ZCONS2*PGFLSLP(JL, JK, Y03%MPSLP)+ZCONS*PPHTE	-zhook handle		
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Note: Allinea DDT can only send input to the aprun process with this MPI implementation				
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Allinea Map

- A product that complements DDT
- A simple code profiler for MPI applications
- Version 5 will support OpenMP as well
- Same source code browser as DDT
- Find hot spots in the application
- Available on the ECMWF systems
- See the DDT/MAP userguide for more information
 - /opt/cray/ddt/4.2.1.2_36484/doc/userguide.pdf



Very Simple Example

```
tar –xzf ~trx/exercises/debug.tgz
cd Debug
compit
edit job.ddt and set DISPLAY
qsub job.ddt
Try setting
```

- a breakpoint at line 26
- a watch point on nthreads
- a conditional trace point on line 50 for nstep 50

Find the error output and trace output when it fails

