Profiling MPI code to identify bottlenecks

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Slides: git.io/fAV4t

MPI, briefly

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- Point-to-all (broadcast) operations
- Collectives, e.g. reductions (sums, maxima, minima, etc.)

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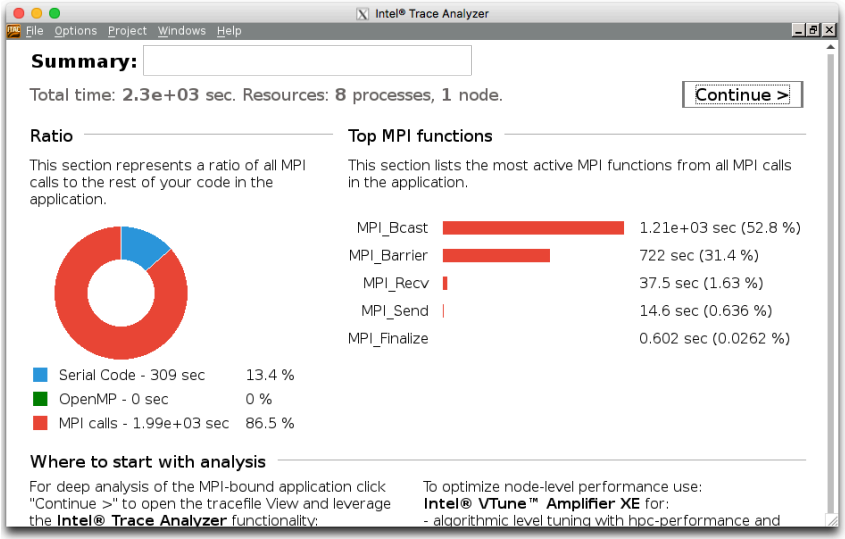
- Visualise the results with `traceanalyzer`

Summary view



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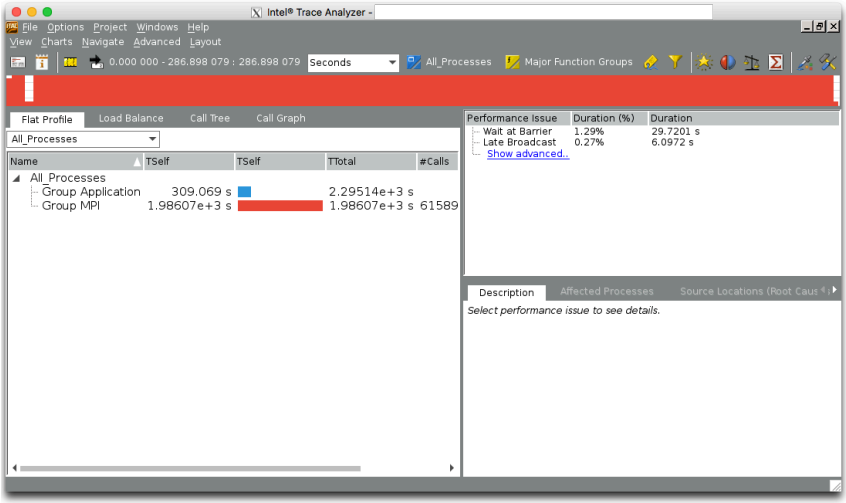
Whole application timeline



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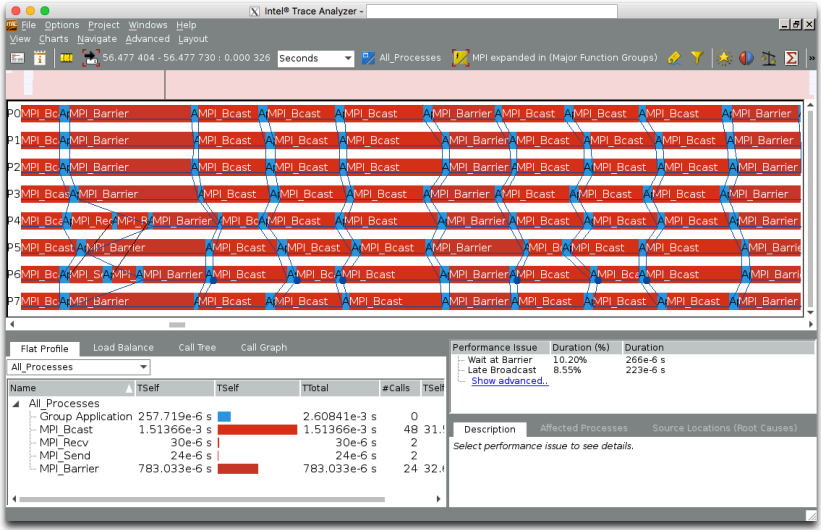
Detailed timeline



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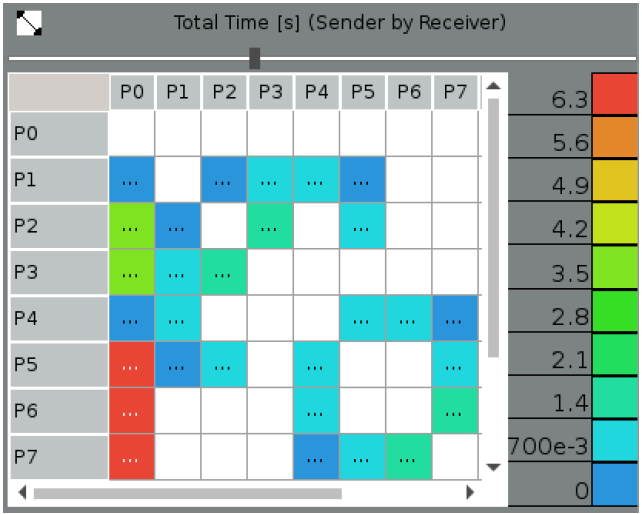
Message pattern



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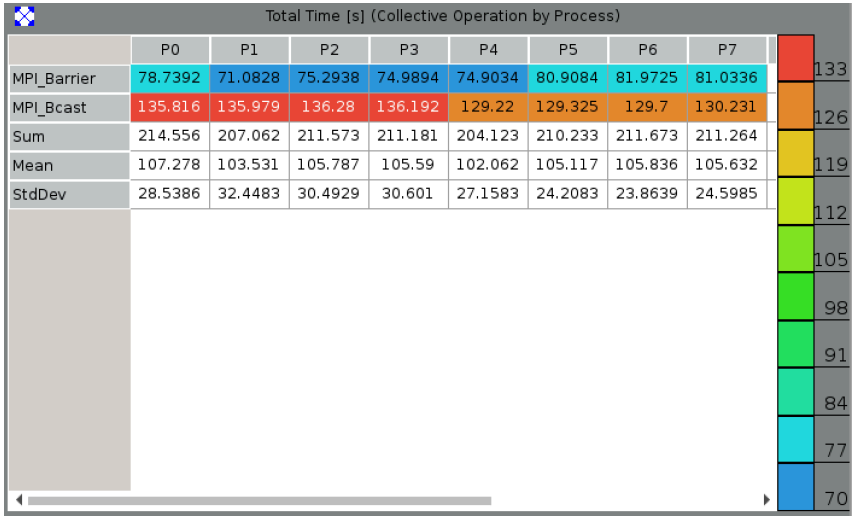
Reductions summary



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  - Is the direction we're parallelising appropriate?
- If that fails, consider more advanced MPI features

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```
call MPI_File_Open(comm, 'con', MPI_Mode_Rdonly, &
MPI_Info_Null, mpi_fh)
call MPI_File_Set_View(mpi_fh, 0_8, MPI_Real, mpiio_type, &
"native", MPI_Info_Null)
call MPI_File_Read_All(mpi_fh, theta, &
3 * ksizex_l * ksizey_l * ksizet_l, &
MPI_Real, status)
call MPI_File_Close(mpi_fh)
```

Subarray types

```
subroutine init_single_halo_type_4(direction, position, size4, datatype, typet)
  integer, intent(in) :: direction, position, size4
  type(MPI_Datatype), intent(in) :: datatype
  type(MPI_Datatype), intent(out) :: typet
  integer, dimension(4) :: sizes, subsizes, starts
  sizes = (/ ksizex_l + 2, ksizey_l + 2, ksizet_l + 2, size4 /)
  subsizes = (/ ksizex_l, ksizey_l, ksizet_l, size4 /)
  subsizes(direction+1) = 1
  starts = (/ 1, 1, 1, 0 /)
  starts(direction+1) = position
  call MPI_Type_Create_Subarray(4, sizes, subsizes, starts, &
                  MPI_Order_Fortran, datatype, typet)
  call MPI_Type_Commit(typet)
  return
end subroutine init_single_halo_type_4
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- Speedup achieved will depend on architecture/communications fabric combination
- Collectives planned for MPI 3.2, e.g. `MPI_AllReduce_Init`

Thanks for listening!

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