Troubleshooting Guidelines for Installing and Using MVAPICH2 and MVAPICH2-X

MVAPICH2 User Group (MUG) Meeting

by

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Outline

• User Resources
• Frequently reported issues and Common mistakes
• Useful Diagnostics
• Performance Troubleshooting
• Getting help and Bug report details
User Resources

- MVAPIVH2 Quick Start Guide
- MVAPICH2 User Guide
  - Long and very detailed
  - FAQ
- MVAPICH2 Web-Site
  - Overview and Features
  - Reference performance
  - Publications
- Mailing List Support
  - mvapich-discuss
- Mailing List Archives
- All above resources accessible from: http://mvapich.cse.ohio-state.edu/
Outline

- User Resources
- Frequently reported issues and Common mistakes
- Useful Diagnostics
- Performance Troubleshooting
- Getting help and Bug report details
Frequently reported issues and Common mistakes

- Job Startup issues
- MPI_Init and Other MPI errors
- Creation of CQ or QP failure
- Failed to register memory with Infiniband HCA
- Multicast group creation failed
- Infiniband setup issues
- MVAPICH2 over RoCE issues
- MPI + OpenMP, Multi-threaded MPI shows bad performance
Job Startup issues

• **Symptoms**
  • [mpirun_rsh][child_handler] Error in init phase, aborting! (0/2 mpispawn connections)

• **Cause**
  • Host file is not correct
  • SSH issues

• **Troubleshooting**
  • Verify host file
  • Password less ssh
  • DNS or /etc/hosts
MPI_Init and Other MPI errors

• **Symptoms**
  • “Fatal error in MPI_Init:
    Other MPI error”

• **Cause**
  • Could be because of multiple reasons

• **Troubleshooting**
  • Reconfigure with –enable-g dbg –enable fast=none to better understand the problem

```
[cli_0]: aborting job:
Fatal error in MPI_Init:
Other MPI error, error stack:
MPIR_Init_thread(408)........:
MPID_Init(308).............: channel initialization failed
MPIDI_CH3_Init(283)........:
MPIDI_CH3I_RDMA_init(171)...:
rdma_setup_startup_ring(389): cannot open hca device
```
Creation of CQ or QP failure

• **Symptoms**
  • libibverbs: Warning: RLIMIT_MEMLOCK is 32768 bytes.
    This will severely limit memory registrations.
  Other MPI error, error stack:
  MPIR_Init_thread(449)........:
  MPID_Init(365)...............: channel initialization failed
  MPIDI_CH3_Init(313).........:
  MPIDI_CH3I_RDMA_init(170)...:
  rdma_setup_startup_ring(416): cannot create cq

• **Cause**
  • Memory buffers used in verbs operations and ib context uses pinned memory
  • Inability to pin the required memory

• **Troubleshooting**
  • Make sure enough memory set for “max locked memory” (limit –l)
  • recommended “unlimited” on all compute nodes
  • User guide section
    • [http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-1360009.4.3](http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-1360009.4.3)
Failed to register memory with InfiniBand HCA

• **Symptoms**
  - “Cannot register vbuf region”
  - “Abort: vbuf pool allocation failed”
  - QP errors, node failures

• **Cause**
  - Limited registered (pinned) memory

• **Troubleshooting**
  - OFED parameters: `log_num_mtt, log_mtts_per_seg`
  - `max_reg_mem = (2^{\text{log_num_mtt}}) * (2^{\text{log_mtts_per_seg}}) * \text{PAGE\_SIZE}`
  - Some OFED default values are too low (< 2GB)
  - clusters with large physical memory (> 64)
  - **Recommendation**: increase `log_num_mtt` value
    - `max_reg_mem = (2^{24}) * (2^{1}) * (4 \text{ kB}) = 128 \text{ GB}`
  - User guide section
    - [http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-1130009.1.1](http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-1130009.1.1)
Multicast group creation failed

- **Symptoms**
  - [host1:mpi_rank_0][create_2level_comm]
  
  Warning: Multicast group setup failed. Not using any multicast features

- **Cause**
  - Umad device permission
  - OpenSM issues

- **Troubleshooting**
  - Check umad device user permissions
    
    $ ls -l /dev/infiniband/umad0
    crw-rw-rw- 1 root root 231, 0 Aug 9 02:04 /dev/infiniband/umad0
  - Slow opensm response
    - MV2_MCAST_COMM_INIT_TIMEOUT
  - Maximum multicast groups reached (very unlikely). Check opensm logs
  - User guide section
    - [http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-620006.9](http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-620006.9)
InfiniBand setup issues

• **Symptoms**
  - [0->6150] send desc error, wc_opcode=0
  - [0->6150] wc.status=12, wc.opcode=0, vbuf->phead->type=25 = XXXX
  - [4979] Abort: [] Got completion with error 12, vendor code=0x81, dest rank=6150
  - wc.status : **12 (IBV_WC_RETRY_EXC_ERR), 13 (IBV_WC_RNR_RETRY_EXC_ERR)**

• **Cause**
  - Bad QP attributes
  - Loose cable, bad HCA or a bad switch blade
  - Remote side is in a bad state
  - Heavy congestion in the network

• **Troubleshooting**
  - MV2_DEFAULT_RETRY_COUNT
  - Map src, dest ranks to host file and check those specific nodes
MVAPICH2 over RoCE issues

- **Symptoms**
  - Intermittent hangs

- **Cause**
  - Most likely setup issues

- **Troubleshooting**
  - Requires loss-less Ethernet fabric
  - Configure Ethernet switch to treat RoCE traffic as loss-less
  - Create a separate VLAN interface
  - All VLAN interfaces appear as additional GID index
  - Select non-default GID index with MV2_DEFAULT_GID_INDEX
  - Use VLAN IP addresses in `/etc/mv2.conf` in RDMA CM mode
  - User guide section
    - [http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-380005.2.7](http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-380005.2.7)
MPI + OpenMP, Multi-threaded MPI shows bad performance

- **Symptoms**
  - Poor performance, hangs

- **Cause**
  - CPU affinity enabled by default
  - All OpenMP, pthreads in the application process bind to same core

- **Troubleshooting**
  - Turn off affinity
    - MV2_ENABLE_AFFINITY = 0
  - Choose binding level
    - MV2_CPU_BINDING_LEVEL=socket
  - User guide section
    - [http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-550006.5](http://mvapich.cse.ohio-state.edu/support/user_guide_mvapich2-2.0a.html#x1-550006.5)
Outline

• User Resources
• Frequently reported issues and Common mistakes
• Useful Diagnostics
• Performance Troubleshooting
• Getting help and Bug report details
Useful Diagnostics

• What parameters are being used by my job?
• Where is the segmentation fault?
• What is the peak memory used by my app?
• Is process binding working as expected?
What parameters are being used by my job?

- **MV2_SHOW_ENV_INFO**
  - Show values of the run time parameters
  - 1 (short list), 2 (full list)

- **Example**

  ```
  $ mpirun_rsh -np 2 --hostfile hfile MV2_SHOW_ENV_INFO=1 ./exec
  ```

  MVAPICH2-2.0a Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROCESSOR ARCH NAME</td>
<td>MV2_ARCH_INTEL_XEON_E5_2680_16</td>
</tr>
<tr>
<td>HCA NAME</td>
<td>MV2_HCA_MLX_CX_FDR</td>
</tr>
<tr>
<td>HETEROGENEOUS</td>
<td>NO</td>
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<tr>
<td>MV2_VBUF_TOTAL_SIZE</td>
<td>17408</td>
</tr>
<tr>
<td>MV2_IBA_EAGER_THRESHOLD</td>
<td>17408</td>
</tr>
<tr>
<td>MV2_RDMA_FAST_PATH_BUF_SIZE</td>
<td>5120</td>
</tr>
<tr>
<td>MV2_EAGERSIZE_1SC</td>
<td>8192</td>
</tr>
<tr>
<td>MV2_PUT_FALLBACK_THRESHOLD</td>
<td>8192</td>
</tr>
<tr>
<td>MV2_GET_FALLBACK_THRESHOLD</td>
<td>0</td>
</tr>
<tr>
<td>MV2_SMP_EAGERSIZE</td>
<td>8193</td>
</tr>
<tr>
<td>MV2_SMPI_LENGTH_QUEUE</td>
<td>524288</td>
</tr>
<tr>
<td>MV2_SMP_NUM_SEND_BUFFER</td>
<td>16</td>
</tr>
<tr>
<td>MV2_SMP_BATCH_SIZE</td>
<td>8</td>
</tr>
</tbody>
</table>
  ```
What parameters are being used by my job? (contd.)

- MPI-T
  - Initial support added in upcoming MVAPICH2 2.0a release
  - Several variables exposed with this interface to the tools
    - Memory allocation and usage information
    - Different collective algorithm invocation counters
    - Shared-memory usage tracing
    - UD retransmission count
    - Progress polling counters
    - Expected and unexpected receive queue matching attempts
    - Many more planned ..
  - Several control variables that can be set/tuned and runtime
What parameters are being used by my job? (contd.)

- MVAPICH2 control variables as seen by a sample tool developed at LLNL

<table>
<thead>
<tr>
<th>Variable</th>
<th>VRB</th>
<th>Class</th>
<th>Type</th>
<th>Bind</th>
<th>R/O</th>
<th>CNT</th>
<th>ATM</th>
</tr>
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<tbody>
<tr>
<td>posted_recvq_length</td>
<td>U/D-2</td>
<td>LEVEL</td>
<td>UINT</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>unexpected_recvq_length</td>
<td>U/D-2</td>
<td>LEVEL</td>
<td>UINT</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>posted_recvq_match_attempts</td>
<td>U/D-2</td>
<td>COUNTER</td>
<td>UNKNOWN</td>
<td>n/a</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>unexpected_recvq_match_attempts</td>
<td>U/D-2</td>
<td>COUNTER</td>
<td>UNKNOWN</td>
<td>n/a</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>time_failed_matching_postedq</td>
<td>U/D-2</td>
<td>TIMER</td>
<td>DOUBLE</td>
<td>n/a</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>time_matching_unexpectedq</td>
<td>U/D-2</td>
<td>TIMER</td>
<td>DOUBLE</td>
<td>n/a</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>unexpected_recvq_buffer_size</td>
<td>U/D-2</td>
<td>LEVEL</td>
<td>UNKNOWN</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mem_allocated</td>
<td>U/B-1</td>
<td>LEVEL</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_progress_poll_count</td>
<td>U/B-1</td>
<td>HIGHWAT</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_rdma_ud_retransmit_count</td>
<td>D/B-7</td>
<td>COUNTER</td>
<td>ULONG</td>
<td>n/a</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>coll_bcast_binomial</td>
<td>D/B-7</td>
<td>COUNTER</td>
<td>ULONG</td>
<td>n/a</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>coll_bcast_scatter_doubling_allgather</td>
<td>U/B-1</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>coll_bcast_scatter_ring_allgather</td>
<td>U/B-1</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_num_2level_comm_requests</td>
<td>U/D-2</td>
<td>COUNTER</td>
<td>ULONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_num_2level_comm_success</td>
<td>U/D-2</td>
<td>COUNTER</td>
<td>ULONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_num_shmem_coll_calls</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_binomial</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_scatter_doubling_allgather</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_scatter_ring_allgather</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_scatter_ring_allgather_shm</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_shmem</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_knomial_internode</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
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<tr>
<td>mv2_coll_bcast_knomial_intranode</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_mcast_internode</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>mv2_coll_bcast_pipeline</td>
<td>T/B-4</td>
<td>COUNTER</td>
<td>ULLONG</td>
<td>n/a</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>
Where is the segmentation fault?

- **MV2_DEBUG_SHOW_BACKTRACE**
  - Shows backtrace with debug builds (--enable-g=dbg, --enable-fast=none)

- **Example**

  - segmentation fault report with out much information
    
    [host1:mpi_rank_0][error_sighandler] Caught error: Segmentation fault (signal 11)

- **mpirun_rsh -np 2 –hostfile hfile MV2_DEBUG_SHOW_BACKTRACE=1 ./exec**
  
  [error_sighandler] Caught error: Segmentation fault (signal 11)
  
  [print_backtrace] 0: libmpich.so.10(print_backtrace+0x22) [0x2af447e29d9a]
  [print_backtrace] 1: libmpich.so.10(error_sighandler+0x7c) [0x2af447e29ef2]
  [print_backtrace] 2: libmpich.so.10(allocate_vbufs+0x71) [0x2af447de6d9f]
  [print_backtrace] 3: libmpich.so.10(rdma_iba_allocate_memory+0x101) [0x2af447dd5ca2]
  [print_backtrace] 4: libmpich.so.10(MPIDI_CH3I_RDMA_init+0x1569) [0x2af447dce9f1]
  [print_backtrace] 5: libmpich.so.10(MPIDI_CH3_Init+0x406) [0x2af447da32f4]
  [print_backtrace] 6: libmpich.so.10(MPI_Init+0x31f) [0x2af447d8a91b]
  [print_backtrace] 7: libmpich.so.10(MPIR_Init_thread+0x3e0) [0x2af447f90aca]
  [print_backtrace] 8: libmpich.so.10(MPI_Init+0x1de) [0x2af447f8f645]
  [print_backtrace] 9: ./mpi_hello() [0x400746]

Where is the segmentation fault?

MVAPICH2 User Group Meeting 2013
What is the peak memory used by my app?

- **MV2_DEBUG_MEM_USAGE_VERBOSE**
  - Show memory usage statistics
  - 1 (rank 0 usage), 2 (all ranks)

- **Example**

  ```
  $ mpirun_rsh -np 2 –hostfile hfile MV2_DEBUG_MEM_USAGE_VERBOSE=1 ./exec
  [mv2_print_mem_usage] VmPeak: 79508 kB VmHWM: 16340 kB
  [mv2_print_vbuf_usage_usage] RC VBUFs:512 UD VBUFs:0 TOT MEM:8828 kB
  ```
Is process binding working as expected?

- **MV2_SHOW_CPU_BINDING**
  - Display CPU binding information
  - Launcher independent

- **Examples**
  - \texttt{MV2_SHOW_CPU_BINDING=1 MV2_CPU_BINDING_POLICY=scatter}
    \hspace{1cm} \textbackslash\texttt{-----------CPU AFFINITY-----------}
    \texttt{RANK:0 CPU\_SET: 0}
    \texttt{RANK:1 CPU\_SET: 8}

  - \texttt{MV2_SHOW_CPU_BINDING=1 MV2_CPU_BINDING_POLICY=core}
    \hspace{1cm} \textbackslash\texttt{-----------CPU AFFINITY-----------}
    \texttt{RANK:0 CPU\_SET: 0}
    \texttt{RANK:1 CPU\_SET: 1}

  - \texttt{MV2_SHOW_CPU_BINDING=1 MV2_CPU_BINDING_POLICY=scatter MV2_CPU_BINDING_LEVEL=socket}
    \hspace{1cm} \textbackslash\texttt{-----------CPU AFFINITY-----------}
    \texttt{RANK:0 CPU\_SET: 0 1 2 3 4 5 6 7}
    \texttt{RANK:1 CPU\_SET: 8 9 10 11 12 13 14 15}

  - \texttt{MV2_SHOW_CPU_BINDING=1 MV2_CPU_BINDING_POLICY=bunch MV2_CPU_BINDING_LEVEL=socket}
    \hspace{1cm} \textbackslash\texttt{-----------CPU AFFINITY-----------}
    \texttt{RANK:0 CPU\_SET: 0 1 2 3 4 5 6 7}
    \texttt{RANK:1 CPU\_SET: 0 1 2 3 4 5 6 7}
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  - Performance Troubleshooting
- Getting help and Bug report details
Performance Trouble shooting

- Check “active_speed” in “ibv_devinfo –v” output
- Check OFED memory registration limits (log_num_mtt, log_mtt_per_seg)
- Increase registration cache size
  - MV2_NDREG_ENTRIES, MV2_NDREG_ENTRIES_MAX
- Are huge pages configured?
- SMP copy block size : MV2_SMP_SEND_BUF_SIZE
- Small message performance
  - RDMA fast path thresholds
    - MV2_NUM_RDMA_BUFFER, MV2_RDMA_FAST_PATH_BUF_SIZE
  - Eager thresholds
    - MV2_IBA_EAGER_THRESHOLD, MV2_VBUF_TOTAL_SIZE
- Large message performance
  - RNDV protocols : MV2_RNDV_PROTOCOL
- Collectives
  - Try different algorithms, change algorithm specific parameters
  - More in later talks
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Getting Help

• Check the MVAPICH2 FAQ
• Check the Mailing List Archives
• Basic System Diagnostics
  – `ibv_devinfo` - at least one port should be PORT_ACTIVE
  – `ulimit -l` should be “unlimited” on all compute nodes
  – host resolution: DNS or `/etc/hosts`
  – password-less ssh login
  – run IB perf tests for all the message sizes (-a option)
    • `ib_send_lat`, `ib_send_bw`
  – run system program (like `hostname`) and MPI hello world program
Getting Help (contd.)

• More diagnostics
  – Already fixed issue: always try with latest release
  – Regression: verifying with previous release
  – Application issue: verify with other MPI libraries
  – Launcher issue: verifying with multiple launchers (mpirun_rsh, mpiexec.hydra)
  – Debug mode
  – Compiler optimization issues: try with different compiler
## Submitting Bug Report

- Subscribe to mvapich-discuss and send problem report
- Include as much information as possible
- Run-time issues
  - Config flags ("mpiname -a" output)
  - Exact command used to run the application
  - Run-rime parameters in the environment
  - Standalone reproducer program
  - Information about the IB network
    - OFED version
    - ibv_devinfo
  - Remote system access
Submitting Bug Report (contd.)

• Build and Installation issues
  – MVAPICH2 version
  – Compiler version
  – Platform details (OS, kernel version..etc)
  – Configure flags
  – Attach Config.log file
  – Attach configure, make and make install step output
    • ./configure {–flags} 2>&1 | tee config.out
    • Make 2>&1 | tee make.out
    • Make install 2>&1 | tee install.out
Web Pointers

NOWLAB Web Page
http://nowlab.cse.ohio-state.edu

MVAPICH Web Page
http://mvapich.cse.ohio-state.edu