NVIDIA DOCA Secure Channel

Application Guide
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DOCA Comm Channel is a secure, network independent communication channel between the host and the NVIDIA® BlueField® DPU.

Comm channel allows the host to control services on the DPU, activate certain offloads, or exchange messages using client-server framework. Communication is based on RDMA queue-pairs (QPs). Each packet that is sent by the QPs consists of two parts: Header and data. The header is a 32-bit structure that holds metadata on the msg to allow the use of a handshake protocol, credit incremental over data packets, and error handling.

The client (host) side is able to communicate only with one server at a time while the server side is able to communicate with multiple clients.

The API allows communication between any PF/VF/SF on the host to the service on the Arm.

Secure channel allows the user to select the message size and amount to be exchanged between the client and the server to simulate heavy load on the channel.
A secure channel application runs on client mode (host) and server mode (DPU). Once a channel is open, messages can flow from both sides. Each endpoint holds 2 RDMA QPs, one for send operations and one for receive operations.
The secure channel application runs on top of the DOCA Comm Channel API. Full connection flow between the client and the server is illustrated in the following:

1. Both sides initiate `create()`.
2. Server listens and waits for new connections.
3. Server initiates `recvfrom()` to indicate it is ready to exchange messages.
4. Client executes `connect()` to server and starts connection initialization.
5. Client sends first message to server.
Chapter 4. DOCA Libraries

This application leverages the DOCA Comm Channel library.
Chapter 5. Configuration Flow

1. Parse application argument.
   a). Initialize the arg parser resources and register DOCA general parameters.
      
      ```c
      doca_argp_init();
      ```
   b). Register application parameters.
      
      ```c
      register_secure_channel_params();
      ```
   c). Parse application flags.
      
      ```c
      doca_argp_start();
      ```

2. Run main logic.
   
   ```c
   sc_start();
   ```
   a). Initiate synchronization mechanism between send and receive threads.
   b). Initiate Comm Channel endpoint.
   c). Server side starts listening for new connections and client side connects to server.
   d). Initiate signal masking and epoll instance.
   e). Start send and receive threads. Both threads share the same Comm Channel so each one must "lock" the channel before any send/receive operation.
   f). Send thread prints total number of messages successfully sent.
   g). Once Ctrl+C is entered in the shell, receive thread prints the total number of messages successfully received.
   h). Close and destroy resources.
Chapter 6. Dependencies

BlueField-2 firmware version 24.35.1012 or later.
Chapter 7. Running the Application

1. Refer to the following documents:
   - NVIDIA DOCA Installation Guide for Linux for details on how to install BlueField-related software.
   - NVIDIA DOCA Troubleshooting Guide for any issue you may encounter with the installation, compilation, or execution of DOCA applications.
   - NVIDIA DOCA Applications Overview for additional compilation instructions and development tips for the DOCA applications.

2. The URL filtering example binary is located under /opt/mellanox/doca/applications/secure_channel/bin/doca_secure_channel. To build all the applications together, run:
   cd /opt/mellanox/doca/applications/
   meson build
   ninja -C build

3. To build only the secure channel application:
   a). Edit the following flags in /opt/mellanox/doca/applications/meson_options.txt:
      ▶ Set enable_all_applications to false
      ▶ Set enable_secure_channel to true
   b). Run the commands in step 2.

   Note: doca_secure_channel will be created under ./build/secure_channel/src/.

Application usage:
Usage: doca_secure_channel [DOCA Flags] [Program Flags]

DOCA Flags:
  -h, --help Print a help synopsis
  -v, --version Print program version information
  -l, --log-level Set the log level for the program <CRITICAL=20, ERROR=30, WARNING=40, INFO=50, DEBUG=60>

Program Flags:
  -s, --msg-size Message size to be sent
  -n, --num-msgs Number of messages to be sent
  -d, --dev-pci Comm Channel DOCA device PCI address
-r, --rep-pci          Comm Channel DOCA device representor PCI address
(needed only on DPU)

Note: For additional information on the app, use -h:
/opt/mellanox/doca/applications/secure_channel/bin/doca_secure_channel -h

4. CLI example for running the app on BlueField:
/opt/mellanox/doca/applications/secure_channel/bin/doca_secure_channel -s 256 -n 10 -d 03:00.0 -r b1:00.0

5. CLI example for running the app on the host:
/opt/mellanox/doca/applications/secure_channel/bin/doca_secure_channel -s 1024 -n 100 -d b1:00.0

Note: Refer to section “Running DOCA Application on Host” in NVIDIA DOCA Virtual Functions User Guide.

6. To run doca_secure_channel using a JSON file:
doca_secure_channel --json [json_file]

For example:
cd /opt/mellanox/doca/applications/secure_channel/bin
./doca_secure_channel --json sc_server_params.json
### Chapter 8. Arg Parser DOCA Flags

Refer to [NVIDIA DOCA Arg Parser User Guide](#) for more information.

<table>
<thead>
<tr>
<th>Flag Type</th>
<th>Short Flag</th>
<th>Long Flag/JSON Key</th>
<th>Description</th>
<th>JSON Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Flags</td>
<td>l</td>
<td>log-level</td>
<td>Sets the log level for the application:</td>
<td>&quot;log-level&quot;:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▶ CRITICAL=20</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▶ ERROR=30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▶ WARNING=40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▶ INFO=50</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>▶ DEBUG=60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>v</td>
<td>version</td>
<td>Print program version information</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>h</td>
<td>help</td>
<td>Print a help synopsis</td>
<td>N/A</td>
</tr>
<tr>
<td>Program Flags</td>
<td>s</td>
<td>msg-size</td>
<td>Message size in bytes</td>
<td>&quot;msg-size&quot;: 128</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><a href="#">Note: This is a mandatory flag.</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>num-msgs</td>
<td>Number of messages to send on both sides</td>
<td>&quot;num-msgs&quot;: 256</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><a href="#">Note: This is a</a></td>
<td></td>
</tr>
<tr>
<td>Flag Type</td>
<td>Short Flag</td>
<td>Long Flag/JSON Key</td>
<td>Description</td>
<td>JSON Content</td>
</tr>
<tr>
<td>-----------</td>
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<td>--------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>mandatory flag.</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>d</td>
<td>dev-pci</td>
<td>Comm Channel DOCA device PCIe address</td>
<td>&quot;dev-pci&quot;: 03:00.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note: This is a mandatory flag.</td>
<td></td>
</tr>
<tr>
<td>r</td>
<td>r</td>
<td>rep-pci</td>
<td>Comm Channel DOCA device representor PCIe address</td>
<td>&quot;rep-pci&quot;: b1:00.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note: This is a mandatory flag.</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 9. References

- /opt/mellanox/doca/applications/secure_channel/src/secure_channel.c
- /opt/mellanox/doca/applications/secure_channel/src/secure_channel_core.c
- /opt/mellanox/doca/applications/secure_channel/src/secure_channel_core.h
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