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WHAT IS SELINUX?

- **Not just something you disable on grub boot line!**
  - It was always the first thing I did on pretty much any system

- **Complicated**
  - Have been developing kernel code for years, yet SELinux still confuses me!
  - Have you tried to write a policy?

- **A good idea**
  - Security is an important topic but not one you should have to worry about
  - It needs to just work and have tools to support
  - Tools like audit2allow – makes life much easier
OK SO WHAT IS IT REALLY?!?

- Detailed explanation well beyond our scope here
- See Dan Jurgen’s presentation from 2016
  - Provides a great overview of SELinux and how it applies to RDMA fabrics
- **Mandatory Access Control (MAC)**
  - Goes beyond normal file permissions
  - Multilevel Security (MLS)
    - Just because user is root doesn’t mean they have an all access pass
    - Regular users can be granted different access depending on roles
- **RDMA fabrics have PKeys so enforce access controls on them**

Example:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>root</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>user1234</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>tux</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
- **Added to the kernel fairly recently (over the last few versions)**
  - Changes are in the IB core and SELinux core
  - Should work with any driver that supports IB verbs

- **Based on PKeys**
  - Is that the best or only option?
  - Time will tell.

- **User space tooling exists**

- **Does not support other protocols**
  - PSM in particular, which is why we have this talk
  - PSM is our preferred communication library
REQUIREMENTS FOR PSM SELINUX

- Support large number of labels
- Use existing PKey scheme
  - For now, who knows what the future will bring
- Support kernel bypass
- Require no changes to user space
  - Enable easy extension if we want to move away from being PKey based
- Require no changes to IB core or SELinux core
  - Enable easy extension if we want to move away from being PKey based
- Be able to work with distro and IFS installations
  - Only changing the hfi1.ko
- Require minimal to no modifications to PSM library
  - Changing user space only if we have to, so far so good
WHAT IS A PKEY?

- **PKey is 16bit non-cryptographic value**
  - Does not need to be a secure value
  - Knowing PKey doesn’t mean you have access to it (AH! So SELinux 😃)

- **hfi1 hardware currently supports PKey checking**
  - Hardware checks all incoming packets to ensure a valid PKey
  - Send/recv contexts and SDMA engines have PKey hardware checks as well

- **hfi1 driver is flexible and can support as many PKeys as needed**
A JKey is a “Job Key”
- Unique to PSM

Allows splitting up partitions further than Pkey
- Many Jkeys in a single partition

Determined by the kernel
- Jkey = 0 has special meaning
- The rest of it is up to software
  - Currently: Use the UID to come up with a JKey
  - JKey space is currently divided up into buckets (that we can change!)
    - admin users
    - kernel protocols
    - everyone else

Using JKey as security field allows flexibility
- To scale to thousands of labels to meet future security needs
- For alternatives to PKey based security
- JKey can be used to hold a flexible security field
- We can use the JKey to hold the index of the PKey
  - This way we can use the JKey hardware checks to validate the PKey
  - Could be something other than PKey some day
- Three JKey buckets becomes Four buckets
  - Exact mapping and format of the JKey is still being finalized
  - Must support sufficient number of JKeys and still maintain job separation
Two ways to send data
- Programmed I/O aka PIO
- Send Direct Memory Access aka SDMA
  - Differ in how data goes from user space to the hfi1 hardware

Hardware supports both
- Tradeoffs to using one vs the other beyond the scope of this talk

PIO
- Kernel bypass

SDMA
- Goes through the kernel for SDMA engine programming
- PSM calls into kernel
- PKey is checked in software
  - Verbs and PSM share SDMA engines
  - Also means JKey can not be checked in hardware
  - Even verbs can have multiple PKeys in packets for a particular SDMA Engine
PIO SEND BEFORE SELINUX

- **verbs**
  - Goes through kernel
  - Multiple QPs and PKeys could be mapped to the same context
  - Thus no HW PKey checks

- **PSM**
  - Kernel bypass
  - Must use HW checks
    - Includes JKey check
- **Verbs**
  - Global PKey table check
  - Limited to 16 Pkeys currently. We can support more.
  - Still has to be a check per QP
- **PSM**
  - Kernel bypass
  - Must use HW
  - Also includes JKey
**SELINUX SDMA SUPPORT**

- **Verbs**
  - Still does PKey check in SW

- **PSM**
  - Still does PKey check in SW
  - Adds additional check of JKey in software
  - Can not use HW JKey checking since SDMA Engines are shared with verbs
  - Same reason we can not use HW PKey checking
### Verbs
- Nothing changes
- Pure SW based

### PSM
- Nothing changes
- Pure HW based
SELINUX RECEIVE SIDE SUPPORT

- **Verbs**
  - Disable PKey checks since
    - Required to support > 16 PKeys
  - Still have to do a PKey check for the QP in software so HW check really not needed anyway

- **PSM**
  - Use JKey check in HW
  - Preserves kernel bypass
CURRENT STATUS

- Under development
- Targeting kernel 4.19 – rough estimate and subject to change
- So far no changes required to
  - PSM
  - IB Core
  - SELinux Core