

# Core Driver Internals

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 3)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 3)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id2" refid="id1">
  :c:type:`struct ssh_ptl <ssh_ptl>`

.. |ssh_ptl| replace:: :c:type:`struct ssh_ptl <ssh_ptl>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 4)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 4)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id4" refid="id3">
  :c:func:`ssh_ptl_submit`

.. |ssh_ptl_submit| replace:: :c:func:`ssh_ptl_submit`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 5)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 5)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id6" refid="id5">
  :c:func:`ssh_ptl_cancel`

.. |ssh_ptl_cancel| replace:: :c:func:`ssh_ptl_cancel`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 6)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 6)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id8" refid="id7">
  :c:func:`ssh_ptl_shutdown`

.. |ssh_ptl_shutdown| replace:: :c:func:`ssh_ptl_shutdown`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 7)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 7)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="idl0" refid="id9">
  :c:func:`ssh_ptl_rx_rcvbuf`

.. |ssh_ptl_rx_rcvbuf| replace:: :c:func:`ssh_ptl_rx_rcvbuf`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 8)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 8)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="idl2" refid="idl1">
  :c:type:`struct ssh_rtl <ssh_rtl>`

.. |ssh_rtl| replace:: :c:type:`struct ssh_rtl <ssh_rtl>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 9)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 9)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="idl4" refid="id13">
  :c:func:`ssh_rtl_submit`

.. |ssh_rtl_submit| replace:: :c:func:`ssh_rtl_submit`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 10)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 10)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="idl6" refid="id15">
  :c:func:`ssh_rtl_cancel`

.. |ssh_rtl_cancel| replace:: :c:func:`ssh_rtl_cancel`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 11)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 11)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="idl8" refid="idl7">
  :c:func:`ssh_rtl_shutdown`

.. |ssh_rtl_shutdown| replace:: :c:func:`ssh_rtl_shutdown`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 12)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 12)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id20" refid="id19">
  :c:type:`struct ssh_packet <ssh_packet>`

.. |ssh_packet| replace:: :c:type:`struct ssh_packet <ssh_packet>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 13)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 13)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id22" refid="id21">
  :c:func:`ssh_packet_get`

.. |ssh_packet_get| replace:: :c:func:`ssh_packet_get`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 14)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 14)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id24" refid="id23">
  :c:func:`ssh_packet_put`

.. |ssh_packet_put| replace:: :c:func:`ssh_packet_put`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 15)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]**

**[driver-api] [surface\_aggregator] internal.rst, line 15)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id26" refid="id25">
  :c:type:`struct ssh_packet_ops <ssh_packet_ops>`

.. |ssh_packet_ops| replace:: :c:type:`struct ssh_packet_ops <ssh_packet_ops>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 16)**

Unknown interpreted text role "c.type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 16)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id28" refid="id27">
  :c:type:`enum ssh_packet_base_priority <ssh_packet_base_priority>`

.. |ssh_packet_base_priority| replace:: :c:type:`enum ssh_packet_base_priority <ssh_packet_base_priority>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 17)**

Unknown interpreted text role "c.type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 17)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id30" refid="id29">
  :c:type:`enum ssh_packet_flags <ssh_packet_flags>`

.. |ssh_packet_flags| replace:: :c:type:`enum ssh_packet_flags <ssh_packet_flags>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 18)**

Unknown interpreted text role "c.func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 18)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id32" refid="id31">
  :c:func:`SSH_PACKET_PRIORITY`

.. |SSH_PACKET_PRIORITY| replace:: :c:func:`SSH_PACKET_PRIORITY`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 19)**

Unknown interpreted text role "c.type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 19)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id34" refid="id33">
```

```
:c:type:`struct ssh_frame <ssh_frame>`  
.. |ssh_frame| replace:: :c:type:`struct ssh_frame <ssh_frame>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 20)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 20)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id36" refid="id35">  
:c:type:`struct ssh_command <ssh_command>`  
.. |ssh_command| replace:: :c:type:`struct ssh_command <ssh_command>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 21)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 21)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id38" refid="id37">  
:c:type:`struct ssh_request <ssh_request>`  
.. |ssh_request| replace:: :c:type:`struct ssh_request <ssh_request>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 22)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 22)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id40" refid="id39">  
:c:func:`ssh_request_get`  
.. |ssh_request_get| replace:: :c:func:`ssh_request_get`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 23)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 23)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id42" refid="id41">  
:c:func:`ssh_request_put`  
.. |ssh_request_put| replace:: :c:func:`ssh_request_put`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 24)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 24)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id44" refid="id43">
  :c:type:`struct ssh_request_ops <ssh_request_ops>`
.. |ssh_request_ops| replace:: :c:type:`struct ssh_request_ops <ssh_request_ops>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 25)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 25)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id46" refid="id45">
  :c:func:`ssh_request_init`
.. |ssh_request_init| replace:: :c:func:`ssh_request_init`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 26)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 26)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id48" refid="id47">
  :c:type:`enum ssh_request_flags <ssh_request_flags>`
.. |ssh_request_flags| replace:: :c:type:`enum ssh_request_flags <ssh_request_flags>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 27)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 27)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id50" refid="id49">
  :c:type:`struct ssam_controller <ssam_controller>`
.. |ssam_controller| replace:: :c:type:`struct ssam_controller <ssam_controller>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 28)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 28)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id52" refid="id51">
  :c:type:`struct ssam_device <ssam_device>`

.. |ssam_device| replace:: :c:type:`struct ssam_device <ssam_device>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 29)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 29)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id54" refid="id53">
  :c:type:`struct ssam_device_driver <ssam_device_driver>`

.. |ssam_device_driver| replace:: :c:type:`struct ssam_device_driver <ssam_device_driver>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 30)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 30)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id56" refid="id55">
  :c:func:`ssam_client_bind`

.. |ssam_client_bind| replace:: :c:func:`ssam_client_bind`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 31)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 31)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id58" refid="id57">
  :c:func:`ssam_client_link`

.. |ssam_client_link| replace:: :c:func:`ssam_client_link`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 32)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]**

[driver-api] [surface\_aggregator] internal.rst, line 32)

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id60" refid="id59">
  :c:type: `struct ssam_request_sync <ssam_request_sync>`

.. |ssam_request_sync| replace:: :c:type: `struct ssam_request_sync <ssam_request_sync>
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 33)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 33)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id62" refid="id61">
  :c:type: `struct ssam_event_registry <ssam_event_registry>`

.. |ssam_event_registry| replace:: :c:type: `struct ssam_event_registry <ssam_event_registry>
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 34)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 34)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id64" refid="id63">
  :c:type: `struct ssam_event_id <ssam_event_id>`

.. |ssam_event_id| replace:: :c:type: `struct ssam_event_id <ssam_event_id>
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 35)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 35)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id66" refid="id65">
  :c:type: `struct ssam_nf <ssam_nf>`

.. |ssam_nf| replace:: :c:type: `struct ssam_nf <ssam_nf>
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 36)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 36)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id68" refid="id67">
```



```
:c:func:`ssam_nf_refcount_inc`  
.. |ssam_nf_refcount_inc| replace:: :c:func:`ssam_nf_refcount_inc`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 37)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 37)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id70" refid="id69">  
:c:func:`ssam_nf_refcount_dec`  
.. |ssam_nf_refcount_dec| replace:: :c:func:`ssam_nf_refcount_dec`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 38)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 38)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id72" refid="id71">  
:c:func:`ssam_notifier_register`  
.. |ssam_notifier_register| replace:: :c:func:`ssam_notifier_register`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 39)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 39)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id74" refid="id73">  
:c:func:`ssam_notifier_unregister`  
.. |ssam_notifier_unregister| replace:: :c:func:`ssam_notifier_unregister`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 40)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 40)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id76" refid="id75">  
:c:type:`struct ssam_cplt <ssam_cplt>`  
.. |ssam_cplt| replace:: :c:type:`struct ssam_cplt <ssam_cplt>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 41)**

Unknown interpreted text role "c:type".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 41)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id78" refid="id77">
    :c:type:`struct ssam_event_queue <ssam_event_queue>`
.. |ssam_event_queue| replace:: :c:type:`struct ssam_event_queue <ssam_event_queue>`
```

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 42)**

Unknown interpreted text role "c:func".

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 42)**

Substitution definition contains illegal element <problematic>:

```
<problematic ids="id80" refid="id79">
    :c:func:`ssam_request_sync_submit`
.. |ssam_request_sync_submit| replace:: :c:func:`ssam_request_sync_submit`
```

Architectural overview of the Surface System Aggregator Module (SSAM) core and Surface Serial Hub (SSH) driver. For the API documentation, refer to:

**System Message: ERROR/3 (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 51)**

Unknown directive type "toctree".

```
.. toctree::
    :maxdepth: 2

    internal-api
```

## Overview

The SSAM core implementation is structured in layers, somewhat following the SSH protocol structure:

Lower-level packet transport is implemented in the *packet transport layer (PTL)*, directly building on top of the serial device (serdev) infrastructure of the kernel. As the name indicates, this layer deals with the packet transport logic and handles things like packet validation, packet acknowledgment (ACKing), packet (retransmission) timeouts, and relaying packet payloads to higher-level layers.

Above this sits the *request transport layer (RTL)*. This layer is centered around command-type packet payloads, i.e. requests (sent from host to EC), responses of the EC to those requests, and events (sent from EC to host). It, specifically, distinguishes events from request responses, matches responses to their corresponding requests, and implements request timeouts.

The *controller* layer is building on top of this and essentially decides how request responses and, especially, events are dealt with. It provides an event notifier system, handles event activation/deactivation, provides a workqueue for event and asynchronous request completion, and also manages the message counters required for building command messages (SEQ, RQID). This layer basically provides a fundamental interface to the SAM EC for use in other kernel drivers.

While the controller layer already provides an interface for other kernel drivers, the client *bus* extends this interface to provide support for native SSAM devices, i.e. devices that are not defined in ACPI and not implemented as platform devices, via `|ssam_device|` and `|ssam_device_driver|` simplify management of client devices and client drivers.

Refer to `Documentation/driver-api/surface_aggregator/client.rst` for documentation regarding the client device/driver API and interface options for other kernel drivers. It is recommended to familiarize oneself with that chapter and the `Documentation/driver-api/surface_aggregator/ssh.rst` before continuing with the architectural overview below.

# Packet Transport Layer

The packet transport layer is represented via `|ssh_ptl|` and is structured around the following key concepts:

## Packets

Packets are the fundamental transmission unit of the SSH protocol. They are managed by the packet transport layer, which is essentially the lowest layer of the driver and is built upon by other components of the SSAM core. Packets to be transmitted by the SSAM core are represented via `|ssh_packet|` (in contrast, packets received by the core do not have any specific structure and are managed entirely via the raw `|ssh_frame|`).

This structure contains the required fields to manage the packet inside the transport layer, as well as a reference to the buffer containing the data to be transmitted (i.e. the message wrapped in `|ssh_frame|`). Most notably, it contains an internal reference count, which is used for managing its lifetime (accessible via `|ssh_packet_get|` and `|ssh_packet_put|`). When this counter reaches zero, the `release()` callback provided to the packet via its `|ssh_packet_ops|` reference is executed, which may then deallocate the packet or its enclosing structure (e.g. `|ssh_request|`).

In addition to the `release` callback, the `|ssh_packet_ops|` reference also provides a `complete()` callback, which is run once the packet has been completed and provides the status of this completion, i.e. zero on success or a negative error value in case of an error. Once the packet has been submitted to the packet transport layer, the `complete()` callback is always guaranteed to be executed before the `release()` callback, i.e. the packet will always be completed, either successfully, with an error, or due to cancellation, before it will be released.

The state of a packet is managed via its `state flags` (`|ssh_packet_flags|`), which also contains the packet type. In particular, the following bits are noteworthy:

- `SSH_PACKET_SF_LOCKED_BIT`: This bit is set when completion, either through error or success, is imminent. It indicates that no further references of the packet should be taken and any existing references should be dropped as soon as possible. The process setting this bit is responsible for removing any references to this packet from the packet queue and pending set.
- `SSH_PACKET_SF_COMPLETED_BIT`: This bit is set by the process running the `complete()` callback and is used to ensure that this callback only runs once.
- `SSH_PACKET_SF_QUEUED_BIT`: This bit is set when the packet is queued on the packet queue and cleared when it is dequeued.
- `SSH_PACKET_SF_PENDING_BIT`: This bit is set when the packet is added to the pending set and cleared when it is removed from it.

## Packet Queue

The packet queue is the first of the two fundamental collections in the packet transport layer. It is a priority queue, with priority of the respective packets based on the packet type (major) and number of tries (minor). See `|SSH_PACKET_PRIORITY|` for more details on the priority value.

All packets to be transmitted by the transport layer must be submitted to this queue via `|ssh_ptl_submit|`. Note that this includes control packets sent by the transport layer itself. Internally, data packets can be re-submitted to this queue due to timeouts or NAK packets sent by the EC.

## Pending Set

The pending set is the second of the two fundamental collections in the packet transport layer. It stores references to packets that have already been transmitted, but wait for acknowledgment (e.g. the corresponding ACK packet) by the EC.

Note that a packet may both be pending and queued if it has been re-submitted due to a packet acknowledgment timeout or NAK. On such a re-submission, packets are not removed from the pending set.

## Transmitter Thread

The transmitter thread is responsible for most of the actual work regarding packet transmission. In each iteration, it (waits for and) checks if the next packet on the queue (if any) can be transmitted and, if so, removes it from the queue and increments its counter for the number of transmission attempts, i.e. tries. If the packet is sequenced, i.e. requires an ACK by the EC, the packet is added to the pending set. Next, the packet's data is submitted to the serdev subsystem. In case of an error or timeout during this submission, the packet is completed by the transmitter thread with the status value of the callback set accordingly. In case the packet is unsequenced, i.e. does not require an ACK by the EC, the packet is completed with success on the transmitter thread.

Transmission of sequenced packets is limited by the number of concurrently pending packets, i.e. a limit on how many packets may be waiting for an ACK from the EC in parallel. This limit is currently set to one (see `Documentation/driver-api/surface_aggregator/ssh.rst` for the reasoning behind this). Control packets (i.e. ACK and NAK) can always be transmitted.

## Receiver Thread

Any data received from the EC is put into a FIFO buffer for further processing. This processing happens on the receiver thread. The receiver thread parses and validates the received message into its `|ssh_frame|` and corresponding payload. It prepares and submits the necessary ACK (and on validation error or invalid data NAK) packets for the received messages.

This thread also handles further processing, such as matching ACK messages to the corresponding pending packet (via sequence ID) and completing it, as well as initiating re-submission of all currently pending packets on receipt of a NAK message (re-submission in case of a NAK is similar to re-submission due to timeout, see below for more details on that). Note that the successful completion of a sequenced packet will always run on the receiver thread (whereas any failure-indicating completion will run on the process where

the failure occurred).

Any payload data is forwarded via a callback to the next upper layer, i.e. the request transport layer.

## Timeout Reaper

The packet acknowledgment timeout is a per-packet timeout for sequenced packets, started when the respective packet begins (re-)transmission (i.e. this timeout is armed once per transmission attempt on the transmitter thread). It is used to trigger re-submission or, when the number of tries has been exceeded, cancellation of the packet in question.

This timeout is handled via a dedicated reaper task, which is essentially a work item (re-)scheduled to run when the next packet is set to time out. The work item then checks the set of pending packets for any packets that have exceeded the timeout and, if there are any remaining packets, re-schedules itself to the next appropriate point in time.

If a timeout has been detected by the reaper, the packet will either be re-submitted if it still has some remaining tries left, or completed with `-ETIMEDOUT` as status if not. Note that re-submission, in this case and triggered by receipt of a NAK, means that the packet is added to the queue with a now incremented number of tries, yielding a higher priority. The timeout for the packet will be disabled until the next transmission attempt and the packet remains on the pending set.

Note that due to transmission and packet acknowledgment timeouts, the packet transport layer is always guaranteed to make progress, if only through timing out packets, and will never fully block.

## Concurrency and Locking

There are two main locks in the packet transport layer: One guarding access to the packet queue and one guarding access to the pending set. These collections may only be accessed and modified under the respective lock. If access to both collections is needed, the pending lock must be acquired before the queue lock to avoid deadlocks.

In addition to guarding the collections, after initial packet submission certain packet fields may only be accessed under one of the locks. Specifically, the packet priority must only be accessed while holding the queue lock and the packet timestamp must only be accessed while holding the pending lock.

Other parts of the packet transport layer are guarded independently. State flags are managed by atomic bit operations and, if necessary, memory barriers. Modifications to the timeout reaper work item and expiration date are guarded by their own lock.

The reference of the packet to the packet transport layer (`ptl`) is somewhat special. It is either set when the upper layer request is submitted or, if there is none, when the packet is first submitted. After it is set, it will not change its value. Functions that may run concurrently with submission, i.e. cancellation, can not rely on the `ptl` reference to be set. Access to it in these functions is guarded by `READ_ONCE()`, whereas setting `ptl` is equally guarded with `WRITE_ONCE()` for symmetry.

Some packet fields may be read outside of the respective locks guarding them, specifically priority and state for tracing. In those cases, proper access is ensured by employing `WRITE_ONCE()` and `READ_ONCE()`. Such read-only access is only allowed when stale values are not critical.

With respect to the interface for higher layers, packet submission (`|ssh_ptl_submit|`), packet cancellation (`|ssh_ptl_cancel|`), data receipt (`|ssh_ptl_rx_rcvbuf|`), and layer shutdown (`|ssh_ptl_shutdown|`) may always be executed concurrently with respect to each other. Note that packet submission may not run concurrently with itself for the same packet. Equally, shutdown and data receipt may also not run concurrently with themselves (but may run concurrently with each other).

## Request Transport Layer

The request transport layer is represented via `|ssh_rtl|` and builds on top of the packet transport layer. It deals with requests, i.e. SSH packets sent by the host containing a `|ssh_command|` as frame payload. This layer separates responses to requests from events, which are also sent by the EC via a `|ssh_command|` payload. While responses are handled in this layer, events are relayed to the next upper layer, i.e. the controller layer, via the corresponding callback. The request transport layer is structured around the following key concepts:

### Request

Requests are packets with a command-type payload, sent from host to EC to query data from or trigger an action on it (or both simultaneously). They are represented by `|ssh_request|`, wrapping the underlying `|ssh_packet|` storing its message data (i.e. SSH frame with command payload). Note that all top-level representations, e.g. `|ssam_request_sync|` are built upon this struct.

As `|ssh_request|` extends `|ssh_packet|`, its lifetime is also managed by the reference counter inside the packet struct (which can be accessed via `|ssh_request_get|` and `|ssh_request_put|`). Once the counter reaches zero, the `release()` callback of the `|ssh_request_ops|` reference of the request is called.

Requests can have an optional response that is equally sent via a SSH message with command-type payload (from EC to host). The party constructing the request must know if a response is expected and mark this in the request flags provided to `|ssh_request_init|`, so that the request transport layer can wait for this response.

Similar to `|ssh_packet|`, `|ssh_request|` also has a `complete()` callback provided via its request ops reference and is guaranteed to be completed before it is released once it has been submitted to the request transport layer via `|ssh_rtl_submit|`. For a request without a response, successful completion will occur once the underlying packet has been successfully transmitted by the packet transport layer (i.e. from within the packet completion callback). For a request with response, successful completion will occur once the response has been received and matched to the request via its request ID (which happens on the packet layer's data-received callback running on the receiver thread). If the request is completed with an error, the status value will be set to the corresponding (negative) errno value.

The state of a request is again managed via its `state` flags (`ssh_request_flags`), which also encode the request type. In particular, the following bits are noteworthy:

- `SSH_REQUEST_SF_LOCKED_BIT`: This bit is set when completion, either through error or success, is imminent. It indicates that no further references of the request should be taken and any existing references should be dropped as soon as possible. The process setting this bit is responsible for removing any references to this request from the request queue and pending set.
- `SSH_REQUEST_SF_COMPLETED_BIT`: This bit is set by the process running the `complete()` callback and is used to ensure that this callback only runs once.
- `SSH_REQUEST_SF_QUEUED_BIT`: This bit is set when the request is queued on the request queue and cleared when it is dequeued.
- `SSH_REQUEST_SF_PENDING_BIT`: This bit is set when the request is added to the pending set and cleared when it is removed from it.

## Request Queue

The request queue is the first of the two fundamental collections in the request transport layer. In contrast to the packet queue of the packet transport layer, it is not a priority queue and the simple first come first serve principle applies.

All requests to be transmitted by the request transport layer must be submitted to this queue via `ssh_rtl_submit`. Once submitted, requests may not be re-submitted, and will not be re-submitted automatically on timeout. Instead, the request is completed with a timeout error. If desired, the caller can create and submit a new request for another try, but it must not submit the same request again.

## Pending Set

The pending set is the second of the two fundamental collections in the request transport layer. This collection stores references to all pending requests, i.e. requests awaiting a response from the EC (similar to what the pending set of the packet transport layer does for packets).

## Transmitter Task

The transmitter task is scheduled when a new request is available for transmission. It checks if the next request on the request queue can be transmitted and, if so, submits its underlying packet to the packet transport layer. This check ensures that only a limited number of requests can be pending, i.e. waiting for a response, at the same time. If the request requires a response, the request is added to the pending set before its packet is submitted.

## Packet Completion Callback

The packet completion callback is executed once the underlying packet of a request has been completed. In case of an error completion, the corresponding request is completed with the error value provided in this callback.

On successful packet completion, further processing depends on the request. If the request expects a response, it is marked as transmitted and the request timeout is started. If the request does not expect a response, it is completed with success.

## Data-Received Callback

The data received callback notifies the request transport layer of data being received by the underlying packet transport layer via a data-type frame. In general, this is expected to be a command-type payload.

If the request ID of the command is one of the request IDs reserved for events (one to `SSH_NUM_EVENTS`, inclusively), it is forwarded to the event callback registered in the request transport layer. If the request ID indicates a response to a request, the respective request is looked up in the pending set and, if found and marked as transmitted, completed with success.

## Timeout Reaper

The request-response-timeout is a per-request timeout for requests expecting a response. It is used to ensure that a request does not wait indefinitely on a response from the EC and is started after the underlying packet has been successfully completed.

This timeout is, similar to the packet acknowledgment timeout on the packet transport layer, handled via a dedicated reaper task. This task is essentially a work-item (re-)scheduled to run when the next request is set to time out. The work item then scans the set of pending requests for any requests that have timed out and completes them with `-ETIMEDOUT` as status. Requests will not be re-submitted automatically. Instead, the issuer of the request must construct and submit a new request, if so desired.

Note that this timeout, in combination with packet transmission and acknowledgment timeouts, guarantees that the request layer will always make progress, even if only through timing out packets, and never fully block.

## Concurrency and Locking

Similar to the packet transport layer, there are two main locks in the request transport layer: One guarding access to the request queue and one guarding access to the pending set. These collections may only be accessed and modified under the respective lock.

Other parts of the request transport layer are guarded independently. State flags are (again) managed by atomic bit operations and, if necessary, memory barriers. Modifications to the timeout reaper work item and expiration date are guarded by their own lock.

Some request fields may be read outside of the respective locks guarding them, specifically the state for tracing. In those cases, proper access is ensured by employing `WRITE_ONCE()` and `READ_ONCE()`. Such read-only access is only allowed when stale values are not critical.

With respect to the interface for higher layers, request submission (`ssh_rtl_submit`), request cancellation (`ssh_rtl_cancel`), and layer shutdown (`ssh_rtl_shutdown`) may always be executed concurrently with respect to each other. Note that request submission may



not run concurrently with itself for the same request (and also may only be called once per request). Equally, shutdown may also not run concurrently with itself.

## Controller Layer

The controller layer extends on the request transport layer to provide an easy-to-use interface for client drivers. It is represented by `|ssam_controller|` and the SSH driver. While the lower level transport layers take care of transmitting and handling packets and requests, the controller layer takes on more of a management role. Specifically, it handles device initialization, power management, and event handling, including event delivery and registration via the (event) completion system (`|ssam_cplt|`).

### Event Registration

In general, an event (or rather a class of events) has to be explicitly requested by the host before the EC will send it (HID input events seem to be the exception). This is done via an event-enable request (similarly, events should be disabled via an event-disable request once no longer desired).

The specific request used to enable (or disable) an event is given via an event registry, i.e. the governing authority of this event (so to speak), represented by `|ssam_event_registry|`. As parameters to this request, the target category and, depending on the event registry, instance ID of the event to be enabled must be provided. This (optional) instance ID must be zero if the registry does not use it. Together, target category and instance ID form the event ID, represented by `|ssam_event_id|`. In short, both, event registry and event ID, are required to uniquely identify a respective class of events.

Note that a further *request ID* parameter must be provided for the enable-event request. This parameter does not influence the class of events being enabled, but instead is set as the request ID (RQID) on each event of this class sent by the EC. It is used to identify events (as a limited number of request IDs is reserved for use in events only, specifically one to `SSH_NUM_EVENTS` inclusively) and also map events to their specific class. Currently, the controller always sets this parameter to the target category specified in `|ssam_event_id|`.

As multiple client drivers may rely on the same (or overlapping) classes of events and enable/disable calls are strictly binary (i.e. on/off), the controller has to manage access to these events. It does so via reference counting, storing the counter inside an RB-tree based mapping with event registry and ID as key (there is no known list of valid event registry and event ID combinations). See `|ssam_nf|`, `|ssam_nf_refcount_inc|`, and `|ssam_nf_refcount_dec|` for details.

This management is done together with notifier registration (described in the next section) via the top-level `|ssam_notifier_register|` and `|ssam_notifier_unregister|` functions.

### Event Delivery

To receive events, a client driver has to register an event notifier via `|ssam_notifier_register|`. This increments the reference counter for that specific class of events (as detailed in the previous section), enables the class on the EC (if it has not been enabled already), and installs the provided notifier callback.

Notifier callbacks are stored in lists, with one (RCU) list per target category (provided via the event ID; NB: there is a fixed known number of target categories). There is no known association from the combination of event registry and event ID to the command data (target ID, target category, command ID, and instance ID) that can be provided by an event class, apart from target category and instance ID given via the event ID.

Note that due to the way notifiers are (or rather have to be) stored, client drivers may receive events that they have not requested and need to account for them. Specifically, they will, by default, receive all events from the same target category. To simplify dealing with this, filtering of events by target ID (provided via the event registry) and instance ID (provided via the event ID) can be requested when registering a notifier. This filtering is applied when iterating over the notifiers at the time they are executed.

All notifier callbacks are executed on a dedicated workqueue, the so-called completion workqueue. After an event has been received via the callback installed in the request layer (running on the receiver thread of the packet transport layer), it will be put on its respective event queue (`|ssam_event_queue|`). From this event queue the completion work item of that queue (running on the completion workqueue) will pick up the event and execute the notifier callback. This is done to avoid blocking on the receiver thread.

There is one event queue per combination of target ID and target category. This is done to ensure that notifier callbacks are executed in sequence for events of the same target ID and target category. Callbacks can be executed in parallel for events with a different combination of target ID and target category.

### Concurrency and Locking

Most of the concurrency related safety guarantees of the controller are provided by the lower-level request transport layer. In addition to this, event (un-)registration is guarded by its own lock.

Access to the controller state is guarded by the state lock. This lock is a read/write semaphore. The reader part can be used to ensure that the state does not change while functions depending on the state to stay the same (e.g. `|ssam_notifier_register|`, `|ssam_notifier_unregister|`, `|ssam_request_sync_submit|`, and derivatives) are executed and this guarantee is not already provided otherwise (e.g. through `|ssam_client_bind|` or `|ssam_client_link|`). The writer part guards any transitions that will change the state, i.e. initialization, destruction, suspension, and resumption.

The controller state may be accessed (read-only) outside the state lock for smoke-testing against invalid API usage (e.g. in `|ssam_request_sync_submit|`). Note that such checks are not supposed to (and will not) protect against all invalid usages, but rather aim to help catch them. In those cases, proper variable access is ensured by employing `WRITE_ONCE()` and `READ_ONCE()`.

Assuming any preconditions on the state not changing have been satisfied, all non-initialization and non-shutdown functions may run concurrently with each other. This includes `|ssam_notifier_register|`, `|ssam_notifier_unregister|`, `|ssam_request_sync_submit|`, as well as

all functions building on top of those.

## Docutils System Messages

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 84); [backlink](#)

Undefined substitution referenced: "ssam\_device".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 84); [backlink](#)

Undefined substitution referenced: "ssam\_device\_driver".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 100); [backlink](#)

Undefined substitution referenced: "ssh\_ptl".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 106); [backlink](#)

Undefined substitution referenced: "ssh\_packet".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 106); [backlink](#)

Undefined substitution referenced: "ssh\_frame".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 113); [backlink](#)

Undefined substitution referenced: "ssh\_frame".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 113); [backlink](#)

Undefined substitution referenced: "ssh\_packet\_get".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 113); [backlink](#)

Undefined substitution referenced: "ssh\_packet\_put".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 113); [backlink](#)

Undefined substitution referenced: "ssh\_packet\_ops".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 113); [backlink](#)

Undefined substitution referenced: "ssh\_request".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator]internal.rst, line 122); [backlink](#)

Undefined substitution referenced: "ssh\_packet\_ops".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 131); [backlink](#)

Undefined substitution referenced: "ssh\_packet\_flags".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 155); [backlink](#)

Undefined substitution referenced: "SSH\_PACKET\_PRIORITY".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 160); [backlink](#)

Undefined substitution referenced: "ssh\_ptl\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 201); [backlink](#)

Undefined substitution referenced: "ssh\_frame".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 279); [backlink](#)

Undefined substitution referenced: "ssh\_ptl\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 279); [backlink](#)

Undefined substitution referenced: "ssh\_ptl\_cancel".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 279); [backlink](#)

Undefined substitution referenced: "ssh\_ptl\_rx\_rcvbuf".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 279); [backlink](#)

Undefined substitution referenced: "ssh\_ptl\_shutdown".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 291); [backlink](#)

Undefined substitution referenced: "ssh\_rtl".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 291); [backlink](#)

Undefined substitution referenced: "ssh\_command".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 291); [backlink](#)

Undefined substitution referenced: "ssh\_command".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 303); [backlink](#)



Undefined substitution referenced: "ssh\_request".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 303); [backlink](#)

Undefined substitution referenced: "ssh\_packet".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 303); [backlink](#)

Undefined substitution referenced: "ssam\_request\_sync".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 310); [backlink](#)

Undefined substitution referenced: "ssh\_request".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 310); [backlink](#)

Undefined substitution referenced: "ssh\_packet".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 310); [backlink](#)

Undefined substitution referenced: "ssh\_request\_get".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 310); [backlink](#)

Undefined substitution referenced: "ssh\_request\_put".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 310); [backlink](#)

Undefined substitution referenced: "ssh\_request\_ops".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 316); [backlink](#)

Undefined substitution referenced: "ssh\_request\_init".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 322); [backlink](#)

Undefined substitution referenced: "ssh\_packet".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 322); [backlink](#)

Undefined substitution referenced: "ssh\_request".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 322); [backlink](#)

Undefined substitution referenced: "ssh\_rtl\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-

master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 335); [backlink](#)

Undefined substitution referenced: "ssh\_request\_flags".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 364); [backlink](#)

Undefined substitution referenced: "ssh\_rtl\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 455); [backlink](#)

Undefined substitution referenced: "ssh\_rtl\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 455); [backlink](#)

Undefined substitution referenced: "ssh\_rtl\_cancel".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 455); [backlink](#)

Undefined substitution referenced: "ssh\_rtl\_shutdown".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 466); [backlink](#)

Undefined substitution referenced: "ssam\_controller".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 466); [backlink](#)

Undefined substitution referenced: "ssam\_cplt".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 483); [backlink](#)

Undefined substitution referenced: "ssam\_event\_registry".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 483); [backlink](#)

Undefined substitution referenced: "ssam\_event\_id".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 493); [backlink](#)

Undefined substitution referenced: "ssam\_event\_id".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 502); [backlink](#)

Undefined substitution referenced: "ssam\_nf".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]  
[driver-api] [surface\_aggregator] internal.rst, line 502); [backlink](#)

Undefined substitution referenced: "ssam\_nf\_refcount\_inc".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 502); [backlink](#)

Undefined substitution referenced: "ssam\_nf\_refcount\_dec".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 510); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_register".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 510); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_unregister".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 517); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_register".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 538); [backlink](#)

Undefined substitution referenced: "ssam\_event\_queue".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 560); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_register".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 560); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_unregister".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 560); [backlink](#)

Undefined substitution referenced: "ssam\_request\_sync\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 560); [backlink](#)

Undefined substitution referenced: "ssam\_client\_bind".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 560); [backlink](#)

Undefined substitution referenced: "ssam\_client\_link".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 569); [backlink](#)

Undefined substitution referenced: "ssam\_request\_sync\_submit".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation]

[driver-api] [surface\_aggregator] internal.rst, line 575); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_register".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 575); [backlink](#)

Undefined substitution referenced: "ssam\_notifier\_unregister".

**System Message: ERROR/3** (D:\onboarding-resources\sample-onboarding-resources\linux-master\Documentation\driver-api\surface\_aggregator\[linux-master] [Documentation] [driver-api] [surface\_aggregator] internal.rst, line 575); [backlink](#)

Undefined substitution referenced: "ssam\_request\_sync\_submit".