

Userspace communication protocol over connector

Message types

There are three types of messages between w1 core and userspace:

1. Events. They are generated each time a new master or slave device is found either due to automatic or requested search.
2. Userspace commands.
3. Replies to userspace commands.

Protocol

```
[struct cn_msg] - connector header.
    Its length field is equal to size of the attached data
[struct w1_netlink_msg] - w1 netlink header.
    __u8 type          - message type.
                        W1_LIST_MASTERS
                            list current bus masters
                        W1_SLAVE_ADD/W1_SLAVE_REMOVE
                            slave add/remove events
                        W1_MASTER_ADD/W1_MASTER_REMOVE
                            master add/remove events
                        W1_MASTER_CMD
                            userspace command for bus master
                            device (search/alarm search)
                        W1_SLAVE_CMD
                            userspace command for slave device
                            (read/write/touch)
    __u8 status        - error indication from kernel
    __u16 len          - size of data attached to this header data
    union {
        __u8 id[8];          - slave unique device id
        struct w1_mst {
            __u32          id;      - master's id
            __u32          res;     - reserved
        } mst;
    } id;

[struct w1_netlink_cmd] - command for given master or slave device.
    __u8 cmd          - command opcode.
                        W1_CMD_READ      - read command
                        W1_CMD_WRITE     - write command
                        W1_CMD_SEARCH    - search command
                        W1_CMD_ALARM_SEARCH - alarm search command
                        W1_CMD_TOUCH     - touch command
                        (write and sample data back to userspace)
                        W1_CMD_RESET     - send bus reset
                        W1_CMD_SLAVE_ADD - add slave to kernel list
                        W1_CMD_SLAVE_REMOVE - remove slave from kernel list
                        W1_CMD_LIST_SLAVES - get slaves list from kernel
    __u8 res          - reserved
    __u16 len         - length of data for this command
                        For read command data must be allocated like for write command
    __u8 data[0]      - data for this command
```

Each connector message can include one or more w1_netlink_msg with zero or more attached w1_netlink_cmd messages.

For event messages there are no w1_netlink_cmd embedded structures, only connector header and w1_netlink_msg structure with "len" field being zero and filled type (one of event types) and id: either 8 bytes of slave unique id in host order, or master's id, which is assigned to bus master device when it is added to w1 core.

Currently replies to userspace commands are only generated for read command request. One reply is generated exactly for one w1_netlink_cmd read request. Replies are not combined when sent - i.e. typical reply messages looks like the following:

```
[cn_msg][w1_netlink_msg][w1_netlink_cmd]
cn_msg.len = sizeof(struct w1_netlink_msg) +
             sizeof(struct w1_netlink_cmd) +
             cmd->len;
w1_netlink_msg.len = sizeof(struct w1_netlink_cmd) + cmd->len;
w1_netlink_cmd.len = cmd->len;
```

Replies to W1_LIST_MASTERS should send a message back to the userspace which will contain list of all registered master ids in the following format:

```
cn_msg (CN_W1_IDX.CN_W1_VAL as id, len is equal to sizeof(struct
w1_netlink_msg) plus number of masters multiplied by 4)
```

```
w1_netlink_msg (type: W1_LIST_MASTERS, len is equal to
                number of masters multiplied by 4 (u32 size))
id0 ... idN
```

Each message is at most 4k in size, so if number of master devices exceeds this, it will be split into several messages.

W1 search and alarm search commands.

request:

```
[cn_msg]
[w1_netlink_msg type = W1_MASTER_CMD
 id is equal to the bus master id to use for searching]
[w1_netlink_cmd cmd = W1_CMD_SEARCH or W1_CMD_ALARM_SEARCH]
```

reply:

```
[cn_msg, ack = 1 and increasing, 0 means the last message,
 seq is equal to the request seq]
[w1_netlink_msg type = W1_MASTER_CMD]
[w1_netlink_cmd cmd = W1_CMD_SEARCH or W1_CMD_ALARM_SEARCH
 len is equal to number of IDs multiplied by 8]
[64bit-id0 ... 64bit-idN]
```

Length in each header corresponds to the size of the data behind it, so `w1_netlink_cmd->len = N * 8`; where N is number of IDs in this message. Can be zero.

```
w1_netlink_msg->len = sizeof(struct w1_netlink_cmd) + N * 8;
cn_msg->len = sizeof(struct w1_netlink_msg) +
              sizeof(struct w1_netlink_cmd) +
              N*8;
```

W1 reset command:

```
[cn_msg]
[w1_netlink_msg type = W1_MASTER_CMD
 id is equal to the bus master id to use for searching]
[w1_netlink_cmd cmd = W1_CMD_RESET]
```

Command status replies

Each command (either root, master or slave with or without `w1_netlink_cmd` structure) will be 'acked' by the w1 core. Format of the reply is the same as request message except that length parameters do not account for data requested by the user, i.e. read/write/touch IO requests will not contain data, so `w1_netlink_cmd.len` will be 0, `w1_netlink_msg.len` will be size of the `w1_netlink_cmd` structure and `cn_msg.len` will be equal to the sum of the `sizeof(struct w1_netlink_msg)` and `sizeof(struct w1_netlink_cmd)`. If reply is generated for master or root command (which do not have `w1_netlink_cmd` attached), reply will contain only `cn_msg` and `w1_netlink_msg` structures.

`w1_netlink_msg.status` field will carry positive error value (EINVAL for example) or zero in case of success.

All other fields in every structure will mirror the same parameters in the request message (except lengths as described above).

Status reply is generated for every `w1_netlink_cmd` embedded in the `w1_netlink_msg`. If there are no `w1_netlink_cmd` structures, reply will be generated for the `w1_netlink_msg`.

All `w1_netlink_cmd` command structures are handled in every `w1_netlink_msg`, even if there were errors, only length mismatch interrupts message processing.

Operation steps in w1 core when new command is received

When new message (`w1_netlink_msg`) is received w1 core detects if it is master or slave request, according to `w1_netlink_msg.type` field. Then master or slave device is searched for. When found, master device (requested or those one on where slave device is found) is locked. If slave command is requested, then reset/select procedure is started to select given device.

Then all requested in `w1_netlink_msg` operations are performed one by one. If command requires reply (like read command) it is sent on command completion.

When all commands (`w1_netlink_cmd`) are processed master device is unlocked and next `w1_netlink_msg` header processing started.

Connector [1] specific documentation

Each connector message includes two u32 fields as "address". w1 uses `CN_W1_IDX` and `CN_W1_VAL` defined in `include/linux/connector.h` header. Each message also includes sequence and acknowledge numbers. Sequence number for event messages is appropriate bus master sequence number increased with each event message sent "through" this master. Sequence number for userspace requests is set by userspace application. Sequence number for reply is the same as was in request, and

acknowledge number is set to seq+1.

Additional documentation, source code examples

1. Documentation/driver-api/connector.rst
2. <http://www.ioremap.net/archive/w1>

This archive includes userspace application w1d.c which uses read/write/search commands for all master/slave devices found on the bus.