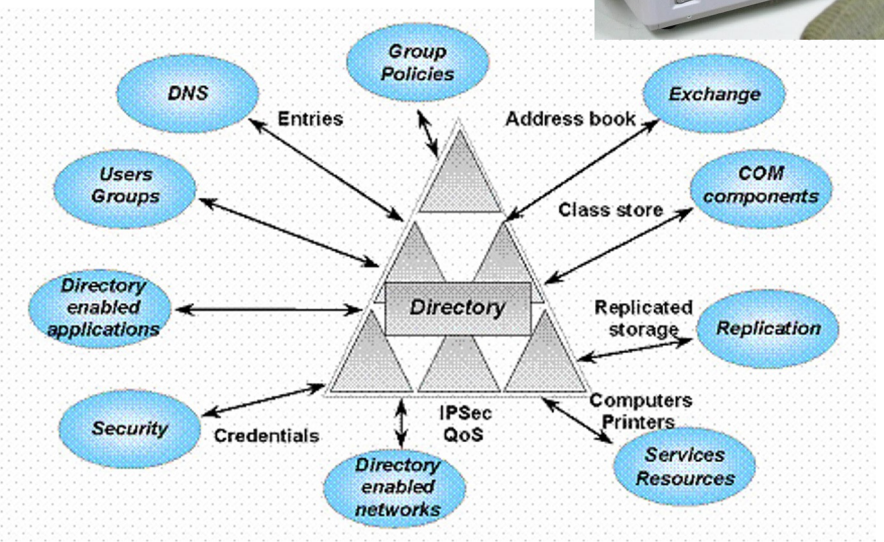
Directory Service

IN2140 Home Exam v2024

What does a directory service do?

- Directory services can be primitive or complex
- In principle, a directory server responds to queries from a user
  - The answer depends on the query
  - But also on the user and their attributes
  - Responses don’t change when query and attributes are unchanged and the directory has not changed
- Different from web search, which sacrifices accuracy for scale and speed

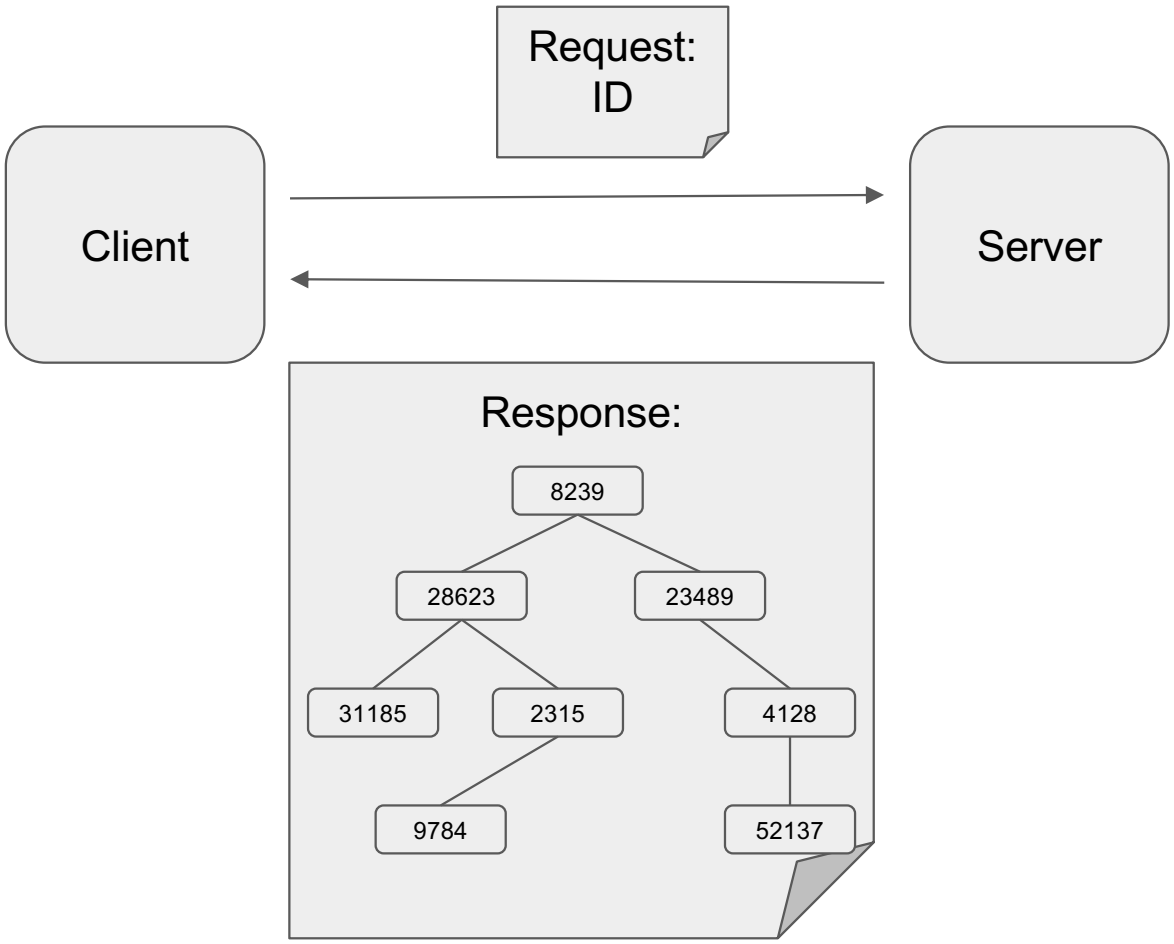


In the exam

A client asks for the directory information for an ID (ID>1000).

The server retrieves several values that are structured in a tree.

The values are simplified to some integers. In a real application these could be user permissions, files, …



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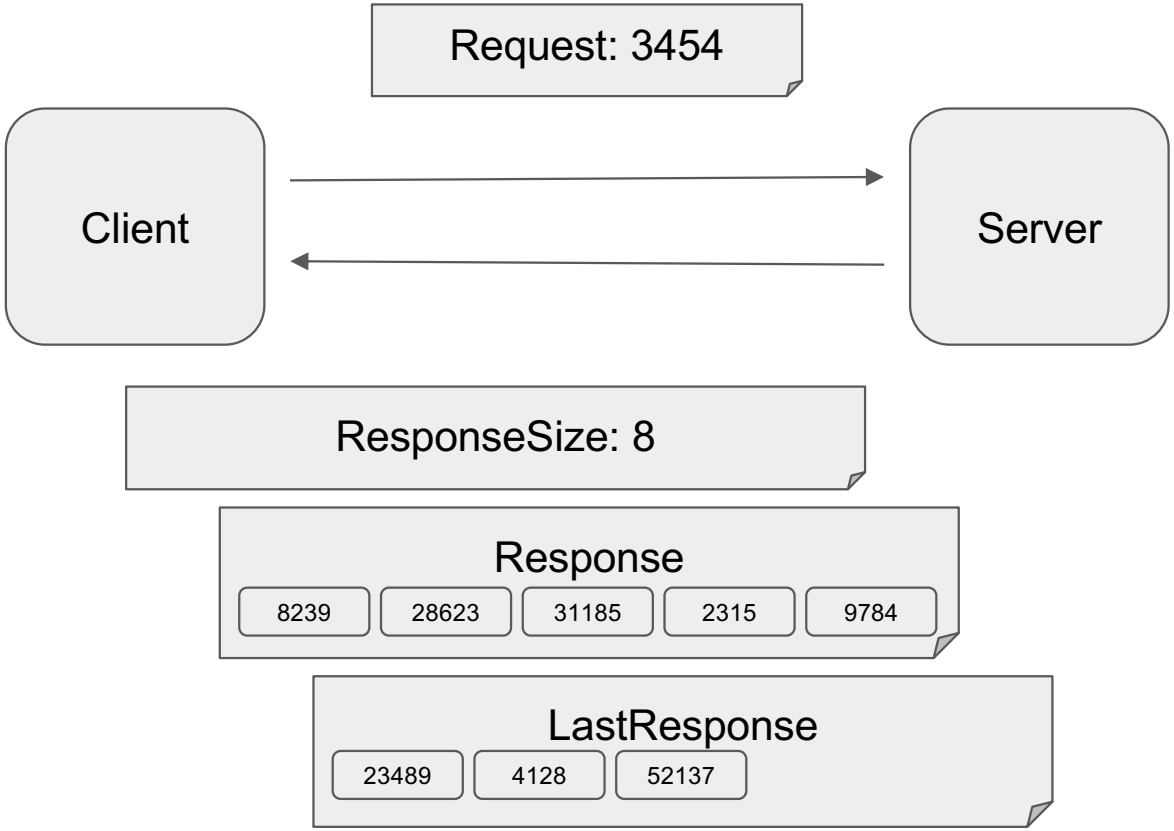
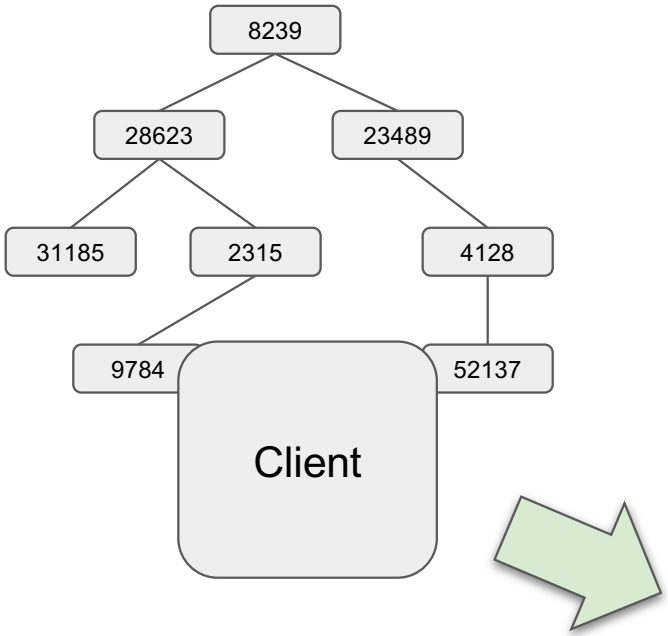


In the exam

The client prints the received response in a tree pattern to the screen.

The output shows the tree structure in a simplified form.

Note: the client and server can store the tree internally however they want.

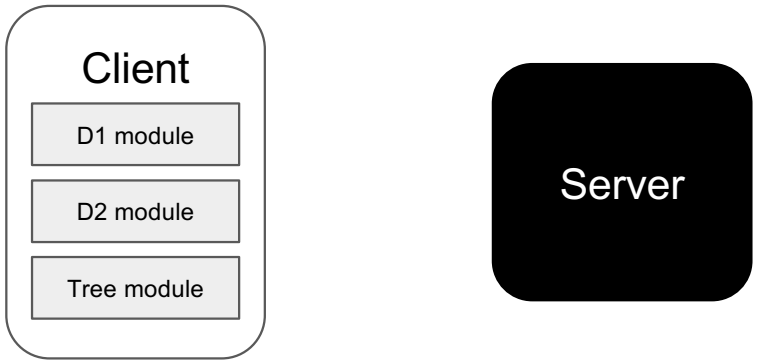



```
8239
--28623
----31185
----2315
------9784
--23489
----4128
------52137
```

In the exam

You implement functions in the client

- The client is a white box, you have the source.
- The client functions are in grey. They are yours, you have some precode.
- The server is a black box, you find binaries on Github.

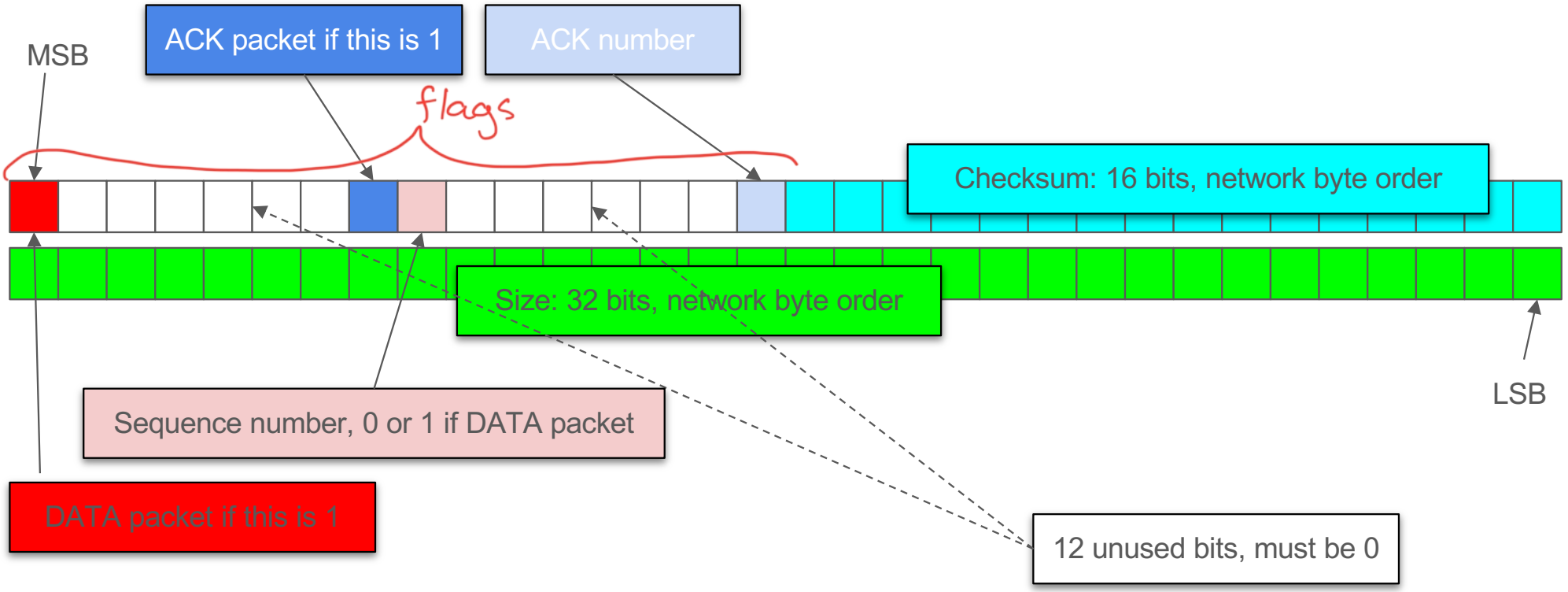


3 steps to do this

1. Communication over UDP
    a. called “D1”
    b. with checksums and 1-bit acknowledgements
2. Request/Response protocol
    a. called “D2”
    b. on top of UDP
    c. relies on correct packet delivery using D1
3. Build a client-side tree from the Responses
    a. Parse the payload of the D2 packets
    b. Recreate the tree on the client side (you don’t have to use pointers)
    c. Print the tree on screen

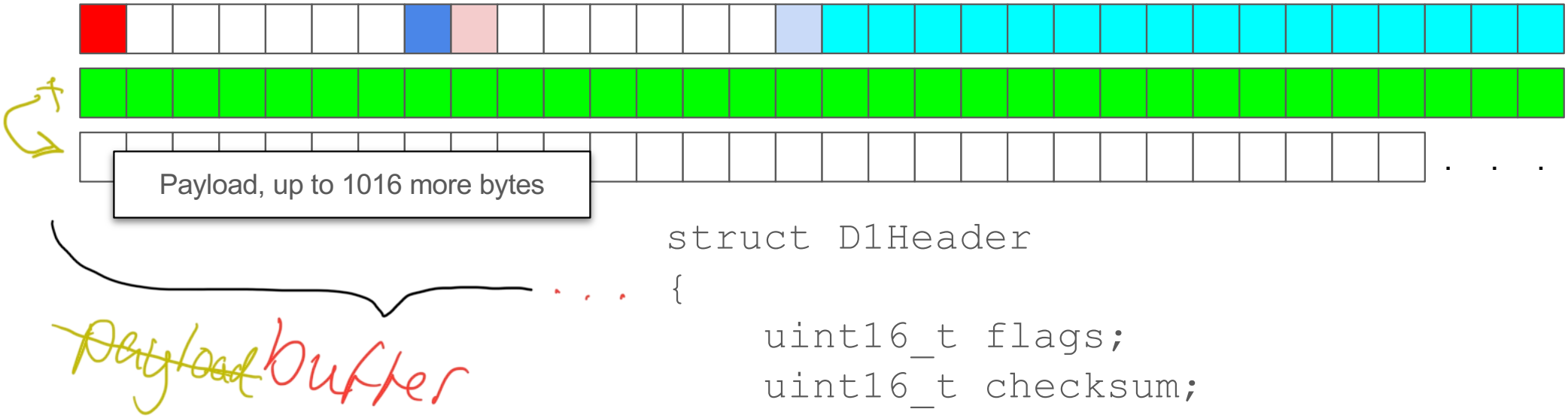
Communication over UDP

The packet header for D1: sent over the network in network byte order



Communication over UDP

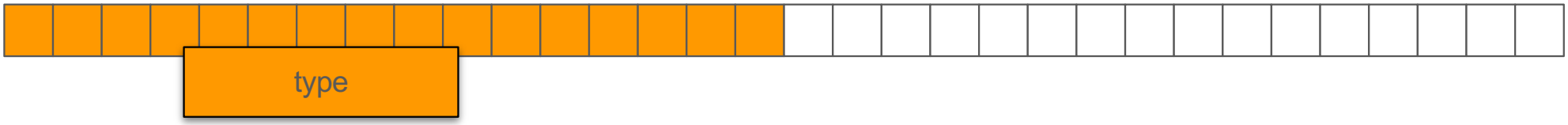
The D1 packet: payload follows D1Header, protected by checksum




```
struct D1Header
{
    uint16_t flags;
    uint16_t checksum;
    uint32_t size;
};
typedef struct D1Header D1Header;
```

D2: Request/Response protocol

The D2 packet: in the payload of the D1 packets (as usual in layering)

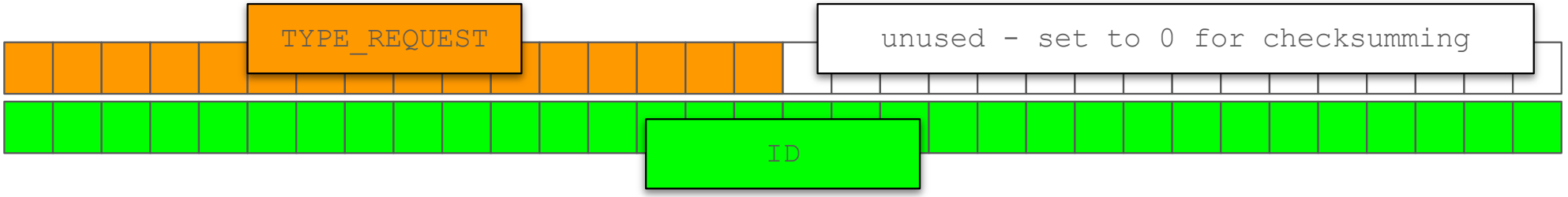



```
struct PacketHeader
{
    uint16_t type;
};
```

```
#define TYPE_REQUEST       (1 << 0) /* type is PacketRequest */
#define TYPE_RESPONSE_SIZE (1 << 1) /* type is PacketResponseSize */
#define TYPE_RESPONSE      (1 << 2) /* type is PacketResponse */
#define TYPE_LAST_RESPONSE (1 << 3) /* type is PacketResponse */
```

D2: Request/Response protocol

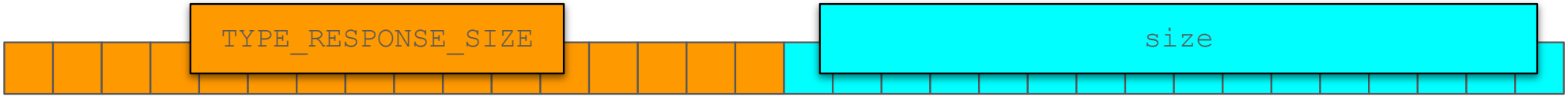
The D2 packet: in the payload of the D1 packets (as usual in layering)




```
struct PacketRequest
{
    uint16_t type;
    uint32_t id;
};
```

D2: Request/Response protocol

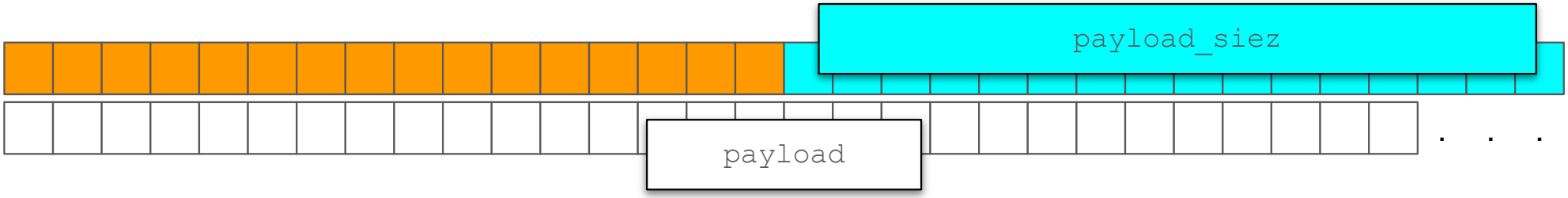
The D2 packet: in the payload of the D1 packets (as usual in layering)




```
struct PacketResponseSize
{
    uint16_t type;
    uint16_t size;
};
```

D2: Request/Response protocol

The D2 packet: in the payload of the D1 packets (as usual in layering)



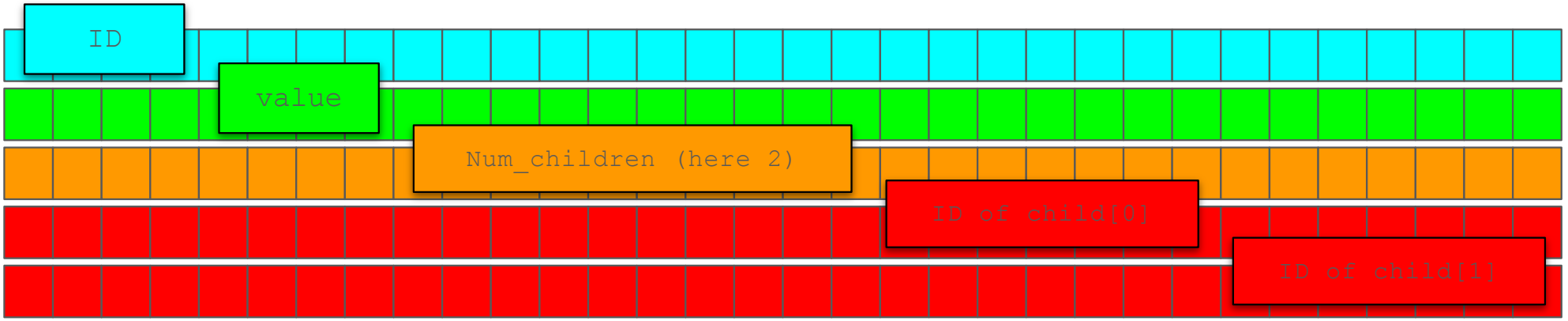

```
struct PacketResponse
{
    uint16_t type;
    uint16_t payload_size;
};
```

TYPE_RESPONSE

OR

TYPE_LAST_RESPONSE

Tree nodes: the payload of D2




```
struct NetNode
{
    uint32_t id;
    uint32_t value;
    uint32_t num_children;
    uint32_t child_id[5];
};
```

id: 0-based index created by depth-first search on the server

value: our MacGuffin

Up to 5 children
But unused children fields are not sent over the network.

The servers

Your client code must talk to our servers

Find binaries at https://github.uio.no/IN2140v2/in2140-v24-he

- d1_dump <port>
  - Send one of your D1 packets to this server. The server checks whether your D1 header is as expected.
- d1_server <port>
  - The d1_test_client with your implementation of d1_udp.c can connect to this server and send a few ping-pong messages.
- d2_server <port>
  - The d2_test_client with your implementations of d1_udp.c and d2_lookup.c can connect to this server. The client sends a Request with an ID and the server answers with several Response packets with tree nodes.

The servers

Your client code must talk to our servers

Find binaries at https://github.uio.no/IN2140v2/in2140-v24-he

- Currently available for
  - Linux Redhat 8.9 on Intel (static binary)
    - this works on IFI's computers, login.ifi and in machines in Sed
  - Linux Ubuntu 22.04 on Intel (static binary)
    - this is popular for home use (and may work with WSL2)
  - MacOS 14.4 Sonoma on Intel (dynamic binary)
    - only Intel; no access to an ARM Mac