bytefield manual

Abstract

bytefield is a package for creating *network protocol headers*, *memory maps*, *register definitions* and more in typst.

Version: 0.0.4
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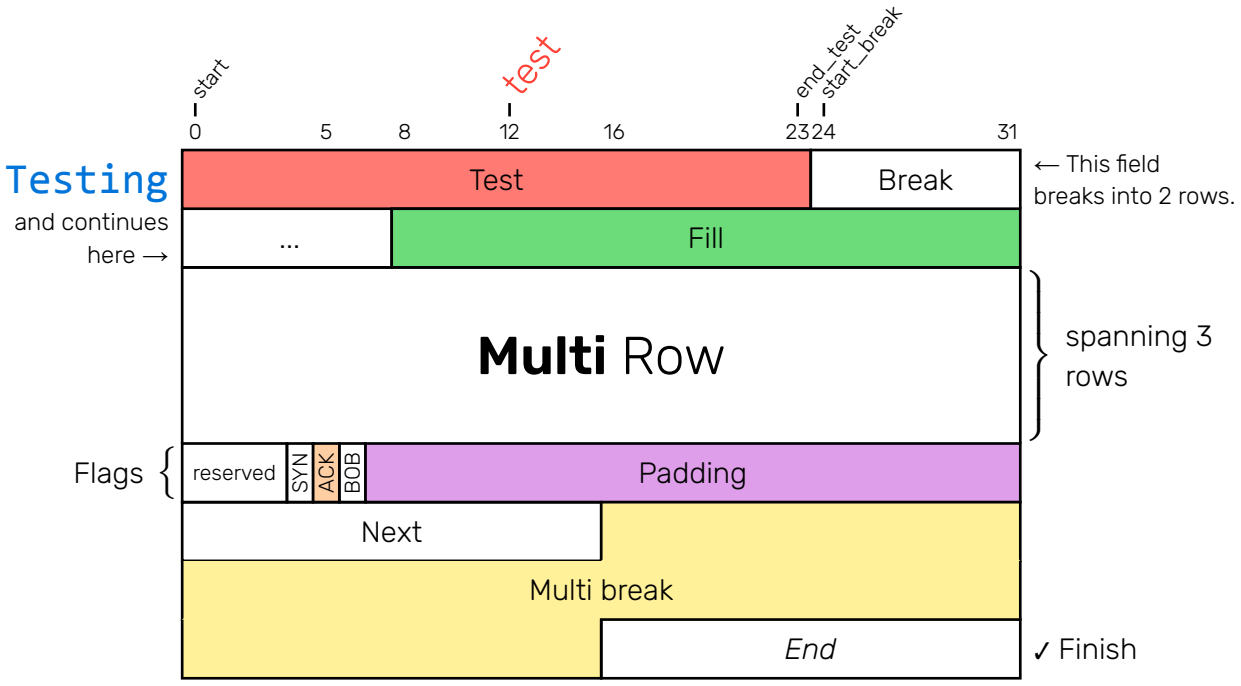
Contents

1. Example



Bytefield 1: Random example of a colored bytefield.

Source and more examples can be found here.

2. Usage

Import the package from the official package manager

```
#import "@preview/bytefield:0.0.4": *
```

or download the package and put it inside the folder for local packages.

3. Features

3.1. Data fields

By default a bytefield shows 32 bits per row. This can be changed by using the `bpr` argument. For example `bpr:16` changes the size to 16 bits per row.

You can add fields of different size to the bytefield by using one of the following field functions.

`bit`, `bits`, `byte`, `bytes`, `flag`

- Fields can be colored with a `fill` argument.

Multirow and breaking fields are supported. This means if a field does not fit into one row it will break automatically into the next one.

3.2. Annotations

Define annotations in columns left or right of the bitfields current row with the helpers `note` and `group`.

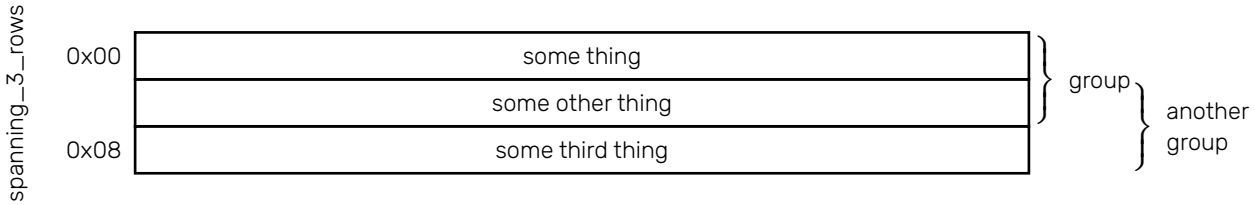
The needed number of columns is determined automatically, but can be forced with the `pre` and `post` arguments.

The helper `note` takes the side it should appear on as first argument, an optional `rowspan` for the number of rows it should span and an optional `level` for the nesting level.

The helper `group` takes the side it should appear on as first argument, as second argument `rowspan` for the number of rows it should span and an optional `level` for the nesting level.

```
#bytefield(
  pre: (1cm,auto),
  post: (auto,1.8cm),
  note(left, rowspan:3, level:1)[
    #align(center,rotate(270deg)[spanning_3_rows])
  ],
  note(left)[0x00],
  group(right,2)[group],
  bytes(4)[some thing],

  // note(left)[0x04],
  group(right,2,level:1)[another group],
  bytes(4)[some other thing],
  note(left)[0x08],
  bytes(4)[some third thing],
)
```



3.3. Headers [WIP]

⚠ The new bitheader api is still a work in progress and might change a bit in the next version.

The current API is described here:

The `bitheader` function defines which bit-numbers and text-labels are shown as a header. Currently **only the first** `bitheader` per `bytefield` is processed, all others will be ignored.

There are some *named* arguments and an arbitrary amount of *positional* arguments which you can pass to a header.

Show or hide numbers
- `numbers: none` hide all numbers
- `numbers: auto` show all specified numbers *default*

Some common use cases can be set by adding a `string` value. *positional*
- `"all"` will show numbers for all bits.
- `"bytes"` will show every multiple of 8 and the last bit.
- `"bounds"` will show begin and end of each field in the first row.
- `"offsets"` will show begin of each field in the first row.

Showing a number. *positional*
- Just add an `int` value with the number you would like to show.

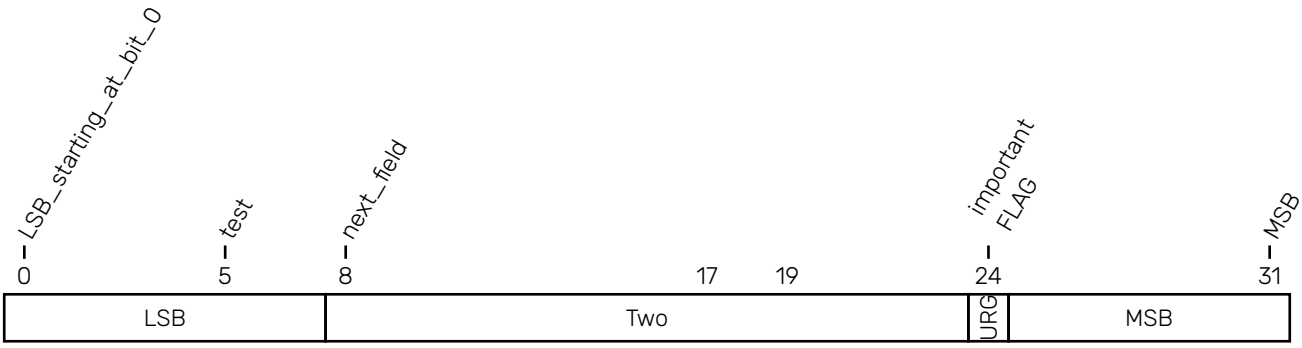
Showing a text label for a number *positional*
- Add a content field after the int value which the label belongs to.

> **Info**
>
> Set the order of the bits with the `msb` argument directly on the `bitheader`.
> - `msb:right` displays the numbers from (left) 0 — to — msb (right) *default*
> - `msb:left` displays the numbers from (left) msb — to — 0 (right)

Numbers and Labels example

You can also show labels and indexes by specifying a `content` after an `number` (`int`).

```
    bitheader(
      0,[LSB_starting_at_bit_0],
      5, [test],
      8, [next_field],
      24, [important FLAG],
      31, [MSB],
      17,19,
```

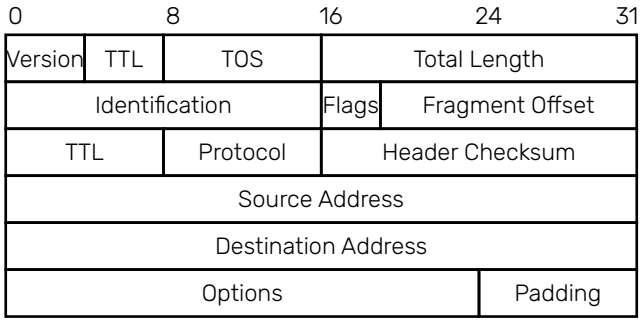


4. Use cases

4.1. Protocol Headers

Generate protocol headers like the one from the **ipv4** protocol.

```
#bytefield(
  bitheader("bytes"),
  bits(4)[Version], bits(4)[TTL], bytes(1)[TOS], bytes(2)[Total Length],
  bytes(2)[Identification], bits(3)[Flags], bits(13)[Fragment Offset],
  bytes(1)[TTL], bytes(1)[Protocol], bytes(2)[Header Checksum],
  bytes(4)[Source Address],
  bytes(4)[Destination Address],
  bytes(3)[Options], bytes(1)[Padding]
)
```

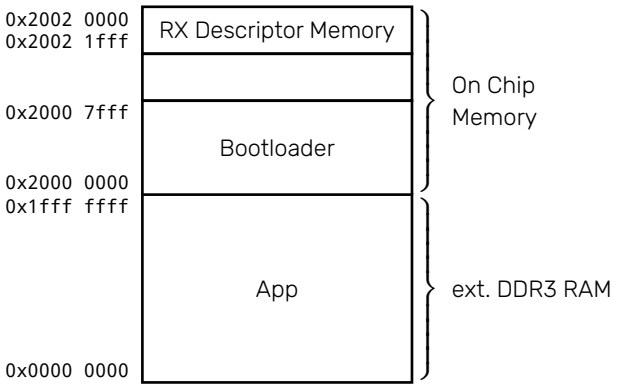


Bytfield 1: Common IPv4 Header.

4.2. Memory Maps

Generate memory maps. Currently possible with a little workaround using bits. Better support is on the roadmap.

```
#bytefield(
  bpr: 1,
  group(right,4)[On Chip Memory],
  section("0x2002 0000", "0x2002 1fff"),
  bit[RX Descriptor Memory],
  bit[],
  section("0x2000 7fff", "0x2000 0000", span: 2),
  bits(2)[Bootloader],
  group(right,4)[ext. DDR3 RAM],
  section("0x1fff ffff", "0x0000 0000", span: 4),
  bits(4)[App],
)
```



Bytefield 2: A memory map example.

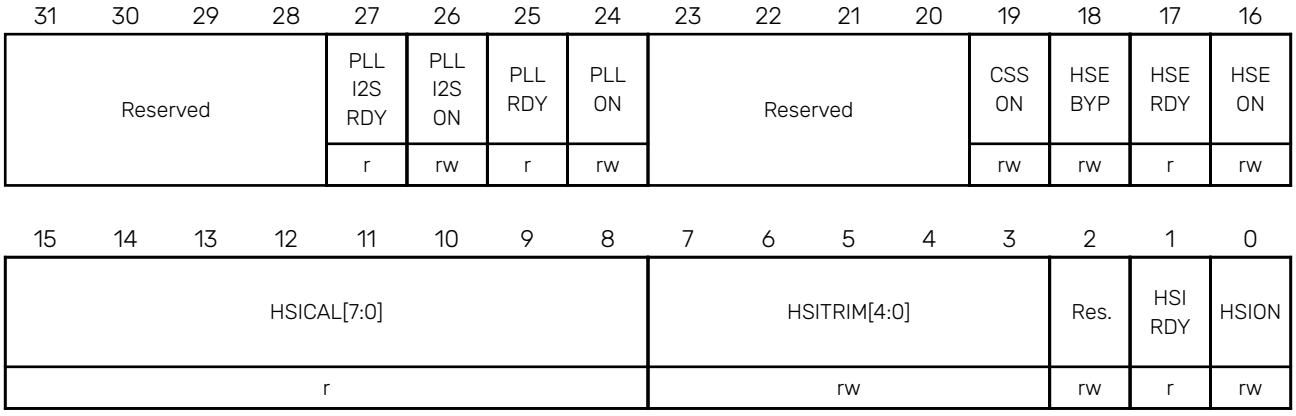
4.3. Register Definitions

Creating register definition like Bytfield 3 is currently possible by using two `bytefields` and tweaking the header accordingly.

```
#let reg_field(body, size: 1, rw: "rw") = {
  bits(size,table(columns: 1fr,rows: (2fr, auto),body,rw))
}

#let reserved(size) = bits(size)[Reserved]

#set text(8pt)
#bytefield(
  bpr: 16,
  msb: left,
  bitheader(range: (16,32), ..range(16,32), msb: left),
  reserved(4),
  reg_field(rw: "r")[PLL I2S RDY],
  reg_field[PLL I2S ON],
  reg_field(rw: "r")[PLL RDY],
  reg_field[PLL ON],
  reserved(4),
  reg_field[CSS ON],
  reg_field[HSE BYP],
  reg_field(rw: "r")[HSE RDY],
  reg_field[HSE ON],
)
#bytefield(
  bpr: 16,
  msb: left,
  bitheader("all", msb: left),
  reg_field(size:8, rw: "r")[HSICAL[7:0]],
  reg_field(size:5)[HSITRIM[4:0]],
  reg_field[Res.],
  reg_field(rw: "r")[HSI RDY],
  reg_field[HSION],
)
```



Bytfield 3: Register Definition from the STM32 manual recreated with `bytefield`

5. Reference

5.1. User API

bytefield

Create a new bytefield.

Example: See Section 4.

Parameters

```
bytefield(
  bpr: int,
  msb,
  pre: auto int relative fraction array,
  post: auto int relative fraction array,
  ..fields: bf-field
) -> bytefield
```

bpr `int`

Number of bits which are shown per row.

Default: `32`

pre `auto` or `int` or `relative` or `fraction` or `array`

This is specifies the columns for annotations on the **left** side of the bytefield

Default: `auto`

post `auto` or `int` or `relative` or `fraction` or `array`

This is specifies the columns for annotations on the **right** side of the bytefield

Default: `auto`

..fields `bf-field`

arbitrary number of data fields, annotations and headers which build the bytefield.

_field

Base for `bit`, `bits`, `byte`, `bytes`, `flag` field functions

⚠ This is just a base function which is used by the other functions and should **not** be called directly.

Parameters

```
_field(
  size: int,
  fill: color,
  body: content
)
```

size `int`

The size of the field in bits.

fill `color`

The background color for the field.

Default: `none`

body `content`

The label which is displayed inside the field.

bit

Add a field of the size of **one bit** to the bytefield

Basically just a wrapper for `_field()`

Parameters

```
bit(..args: arguments)
```

..args `arguments`

All arguments which are accepted by `_field`

bits

Add a field of a given size of bits to the bytefield

Basically just a wrapper for `_field()`

Parameters

```
bits(
  len: int,
  ..args: arguments
)
```

len `int`

Size of the field in bits

..args `arguments`

All arguments which are accepted by `_field`

byte

Add a field of the size of one byte to the bytefield

Basically just a wrapper for `_field()`

Parameters

```
byte(..args: arguments)
```

..args `arguments`

All arguments which are accepted by `_field`

bytes

Add a field of the size of multiple bytes to the bytefield

Basically just a wrapper for `_field()`

Parameters

```
bytes(
  len: int,
  ..args: arguments
)
```

len `int`

Size of the field in bytes

..args `arguments`

All arguments which are accepted by `_field`

flag

Add a flag to the bytefield.

Basically just a wrapper for `_field()`

Parameters

```
flag(
  text: content,
  ..args: arguments
)
```

text `content`

The label of the flag which is rotated by `270deg`

..args `arguments`

All arguments which are accepted by `_field`

padding

Add a field which extends to the end of the row

⚠ This can cause problems with `msb:left`

Parameters

```
padding(..args: arguments)
```

..args `arguments`

All arguments which are accepted by `_field`

note

Create a annotation

The note is always shown in the same row as the next data field which is specified.

Parameters

```
note(
  side: left right,
  rowspan: int,
  level: int,
  inset: length,
  bracket: bool,
  content: content
)
```

side `left` or `right`

Where the annotation should be displayed

rowspan `int`

Defines if the cell is spanned over multiple rows.

Default: `1`

level `int`

Defines the nesting level of the note.

Default: `0`

inset `length`

Inset of the the annotation cell.

Default: `5pt`

bracket `bool`

Defines if a bracket will be shown for this note.

Default: `false`

content `content`

The content of the note.

group

Shows a note with a bracket and spans over multiple rows.

Basically just a shortcut for the `note` field with the argument `bracket:true` by default.

Parameters

```
group(
  side,
  rowspan,
  level,
  bracket,
  content
)
```

section

Shows a special note with a start_addr (top aligned) and end_addr (bottom aligned) on the left of the associated row.

⚠ **experimental:** This will probably change in a future version.

Parameters

```
section(
  start_addr: string content,
  end_addr: string content,
  span
)
```

start_addr `string` or `content`

The start address will be top aligned

end_addr `string` or `content`

The end address will be bottom aligned

bitheader

Config the header on top of the bytefield

By default no header is shown.

Parameters

```
bitheader(
  msb: left right,
  range: array,
  autofill: string,
  numbers: auto none,
  ..args: int content
)
```

msb `left` or `right`

This sets the bit order

Default: `right`

range `array`

Specify the range of number which are displayed on the header. Format: `(start, end)`

Default: `(auto,auto)`

autofill `string`

Specify on of the following options and let bytefield calculate the numbers for you.
- `"bytes"` shows each multiple of 8 and the last number of the row.
- `"all"` shows all numbers.
- `"bounds"` shows a number for every start and end bit of a field.
- `"offsets"` shows a number for every start bit of a field.

Default: `auto`

numbers `auto` or `none`

if none is specified no numbers will be shown on the header. This is useful to show only labels.

Default: `auto`

..args `int` or `content`

The numbers and labels which should be shown on the header. The number will only be shown if it is inside the range. If a `content` value follows a `int` value it will be interpreted as label for this number. For more information see the *manual*.