



RTOS for microcontrollers with memory protection

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Who would win?

DEC PDP-7

1964

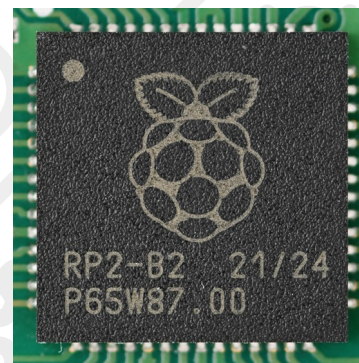
\$72,000



Raspberry Pi RP2040

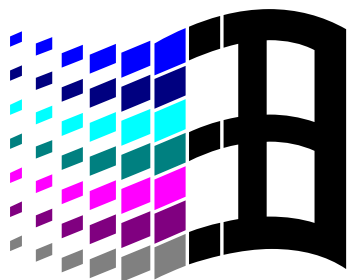
2021

1.16 €



Who am I?

- Read „Principles of Operating Systems“ instead of „The Little Prince“
- In 1999, randomly spotted article: „QNX: Operating system on a single floppy“
- Nomading across industries, ending up in automotive, then switching to freelance.



ThreadX



s complicated"

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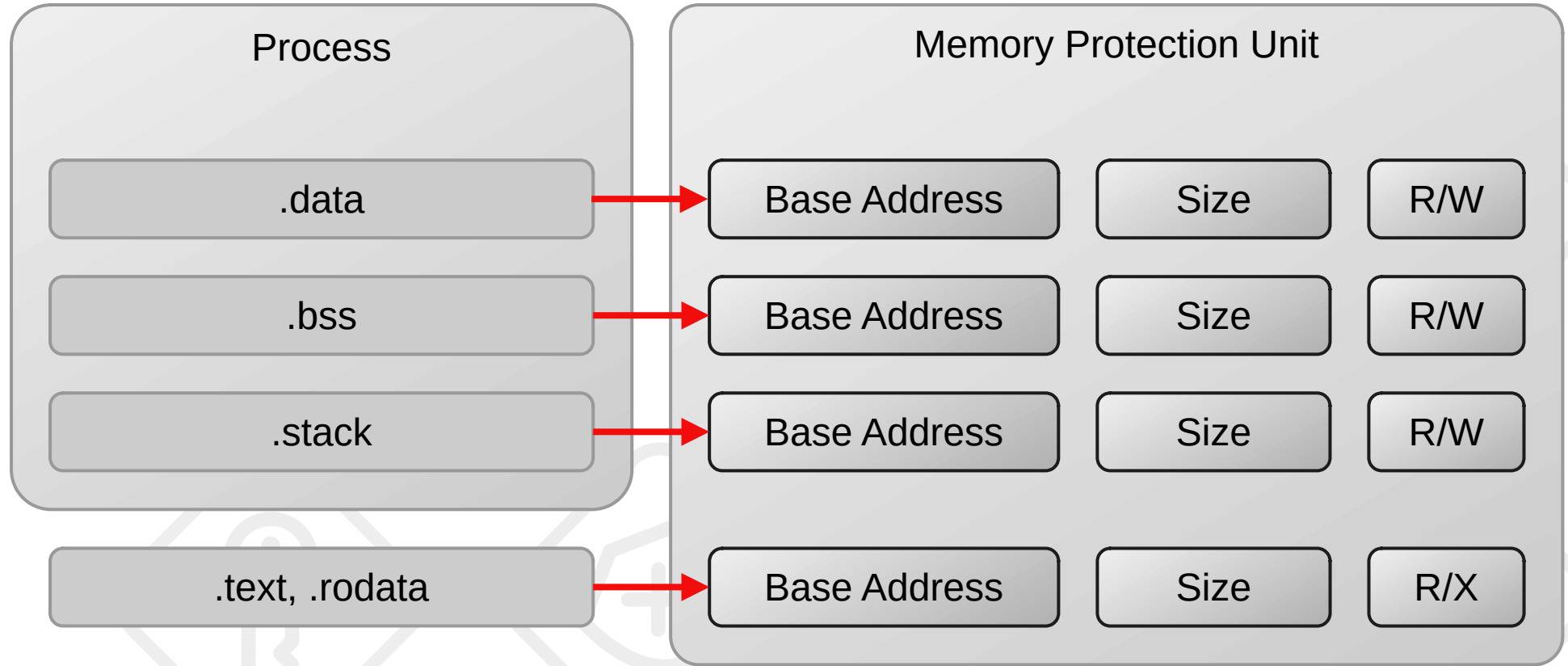
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What if...

...we could simply write this?

```
/* Variables that are only accessible by the process */  
#define BUFSIZE 512  
static char buffer[BUFSIZE];  
  
static int blinky_main()  
{  
    /* Do something interesting */  
    return 0;  
}  
  
OS_APPLICATION(blinky);  
OS_THREAD_CREATE(blinky, blinky_main, NULL, 32);
```

Isolation Using Processes



OK, but...

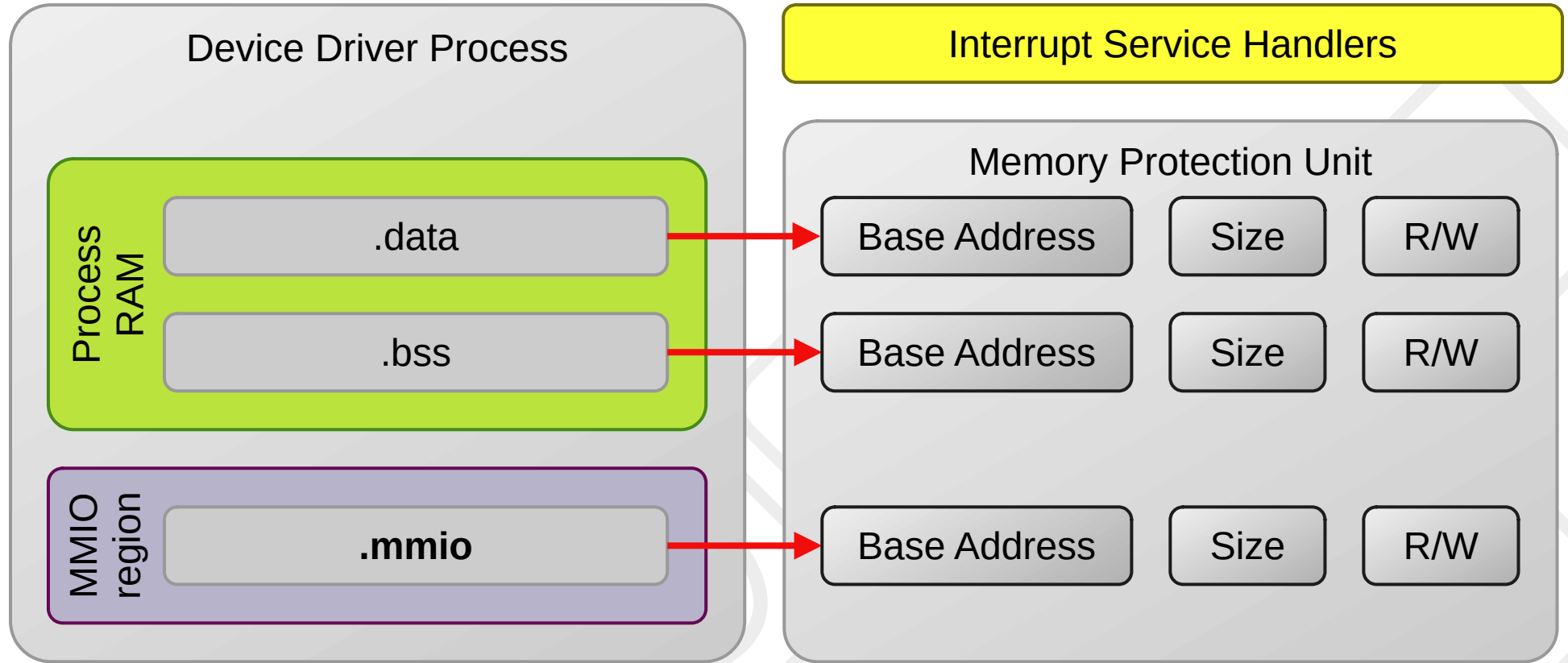
...manual approach can access peripherals. This, can't!

```
/* Variables that are only accessible by the process */
#define BUFSIZE 512
static char buffer[BUFSIZE];

static int blinky_main()
{
    /* Do something interesting */
    return 0;
}

/* Accidentally, these are where RP2040 GPIO is mapped to */
OS_APPLICATION_MMIO_RANGES(blinky, 0x40000000, 0x50000000, 0xd0000000, 0xe0000000);
OS_APPLICATION(blinky);
OS_THREAD_CREATE(blinky, blinky_main, NULL, 32);
```

Drivers in Userspace

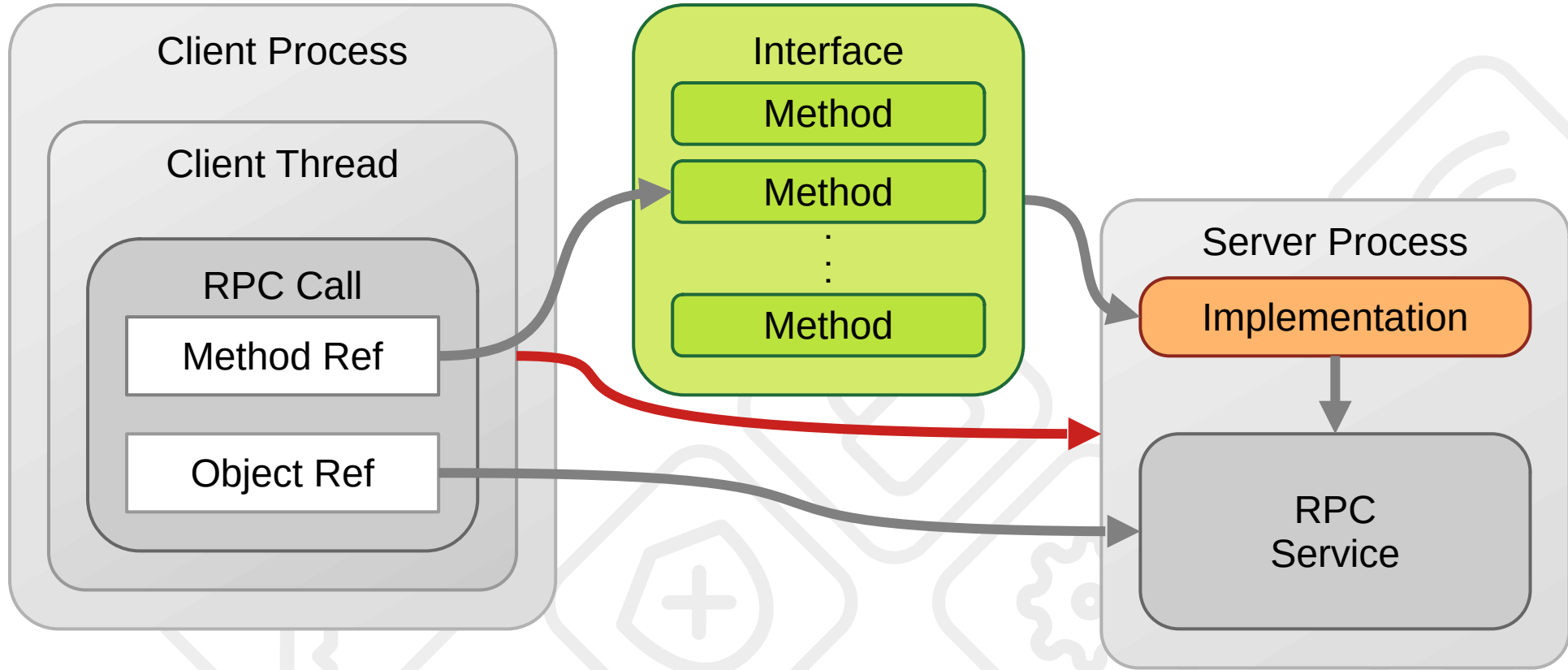


OK, but...

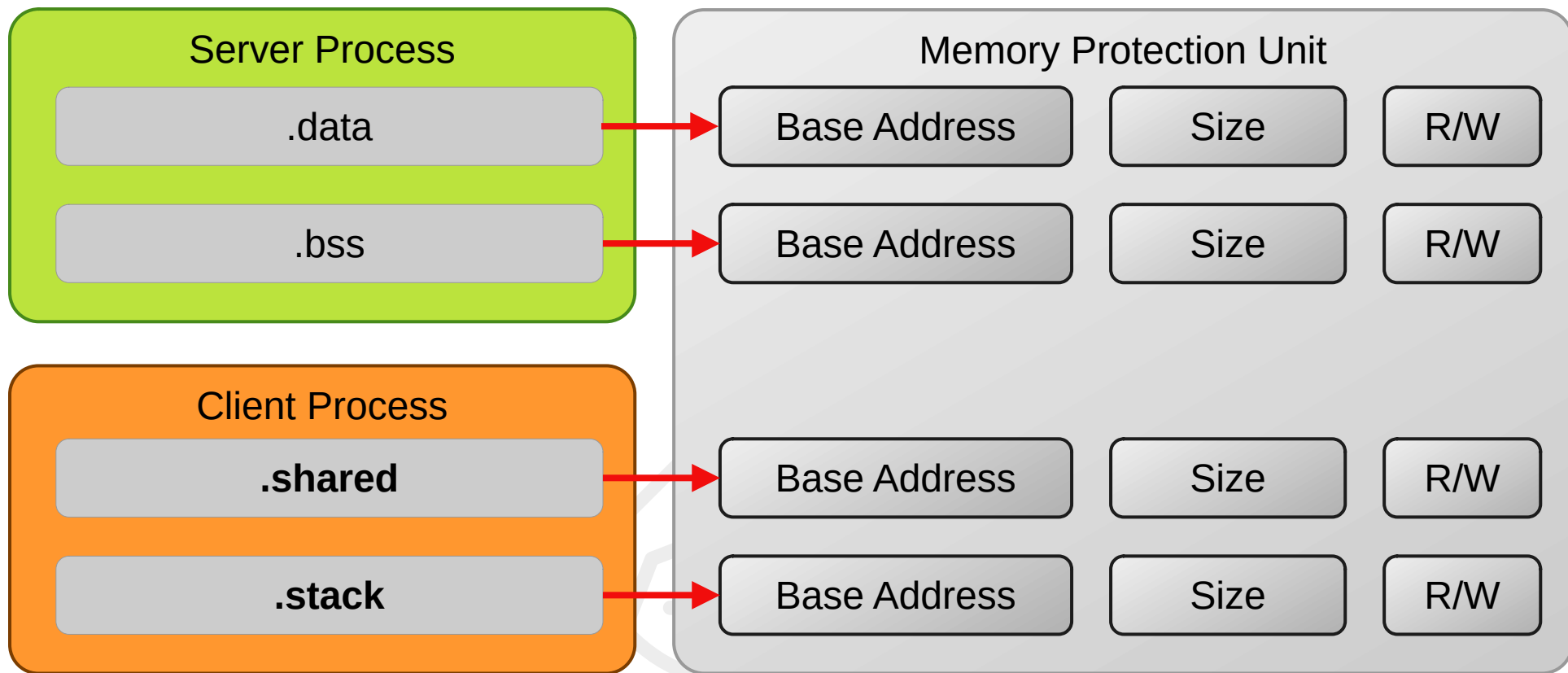
...manual approach can create shared memory. This, can't!

```
/* Variables that are only accessible by the process */  
#define BUFSIZE 512  
SHARED static char buffer[BUFSIZE];  
  
static int blinky_main()  
{  
    /* Do something interesting */  
    return 0;  
}  
  
OS_APPLICATION(blinky);  
OS_THREAD_CREATE(blinky, blinky_main, NULL, 32);
```

Remote Procedure Calling



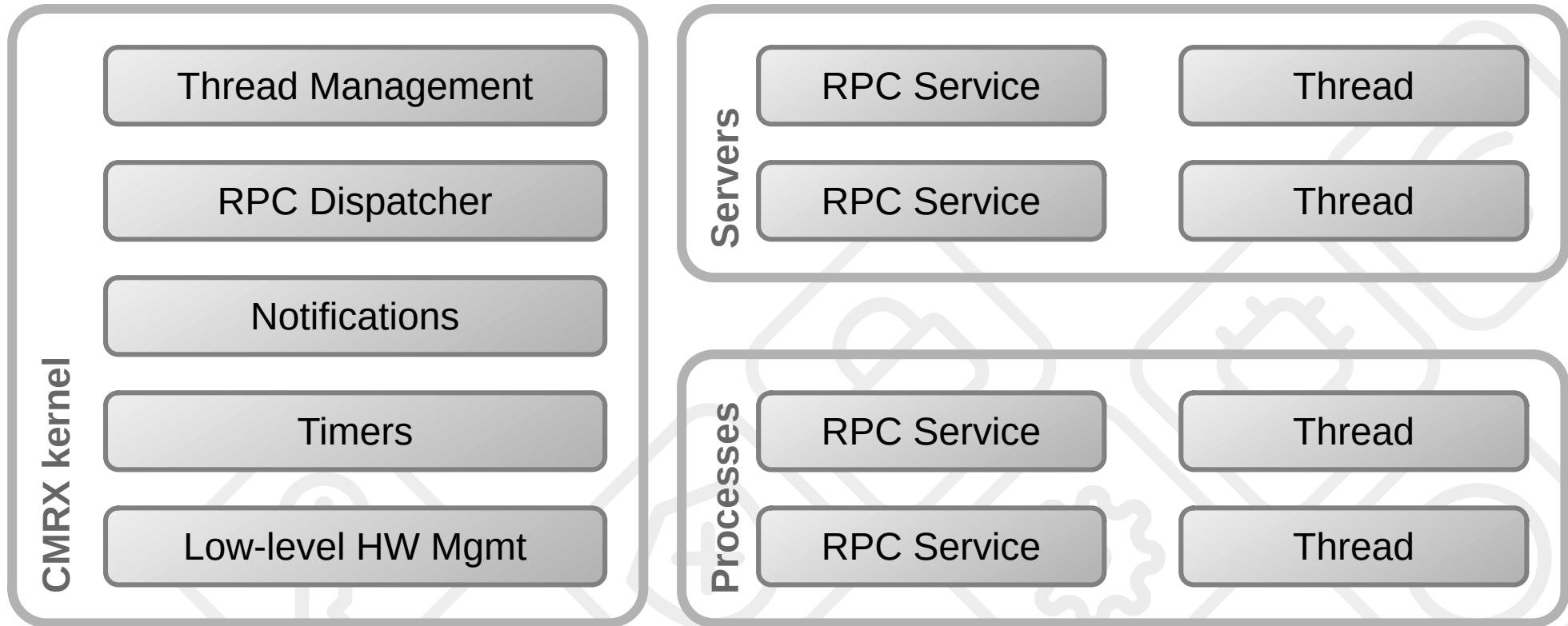
RPC Enables Shared Memory



Recap

- Total memory isolation, always done right with just one additional line of code.
- Same memory isolation for drivers with just one other additional line of code.
- Isolation domain and shared memory scale without being bound by MPU hardware.
- Cross-process calls type-checked at compile time.

CMRX microkernel



Why should I care?

- CRA recognizes memory isolation as technical requirement (ETSI EN 304 626 draft, TR-MISO)
- Memory isolation may* be required for certain devices
- **Device manufacturers** must „*Quickly inform users about incidents and provide mitigation measures.*“
- Stating that your product is not affected due component integration specifics **is valid mitigation measure.**
- Fixing vulnerability still mandatory.

Thank you!

Q&A



<https://cmrxrtos.org>

<https://github.com/ventzl/cmrx>

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