Asymmetric Multiprocessing and Embedded Linux

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Who are we?

- Marek NOVAK
  - Author/maintainer of RPMsg-Lite library
  - PhD student
- Dusan CERVENKA
  - Author/maintainer of eRPC library
- Both
  - Linux entousiasts
  - Working at NXP Semiconductors

Outline

Asymmetric Multiprocessing (AMP)

Remote Processor Messaging (RPMsg) in Linux kernel

RPMsg-Lite – RPMsg for RTOS

Embedded Remote Procedure Call (eRPC)

Asymmetric Multiprocessing (AMP)

Motivation – why AMP? 1/2

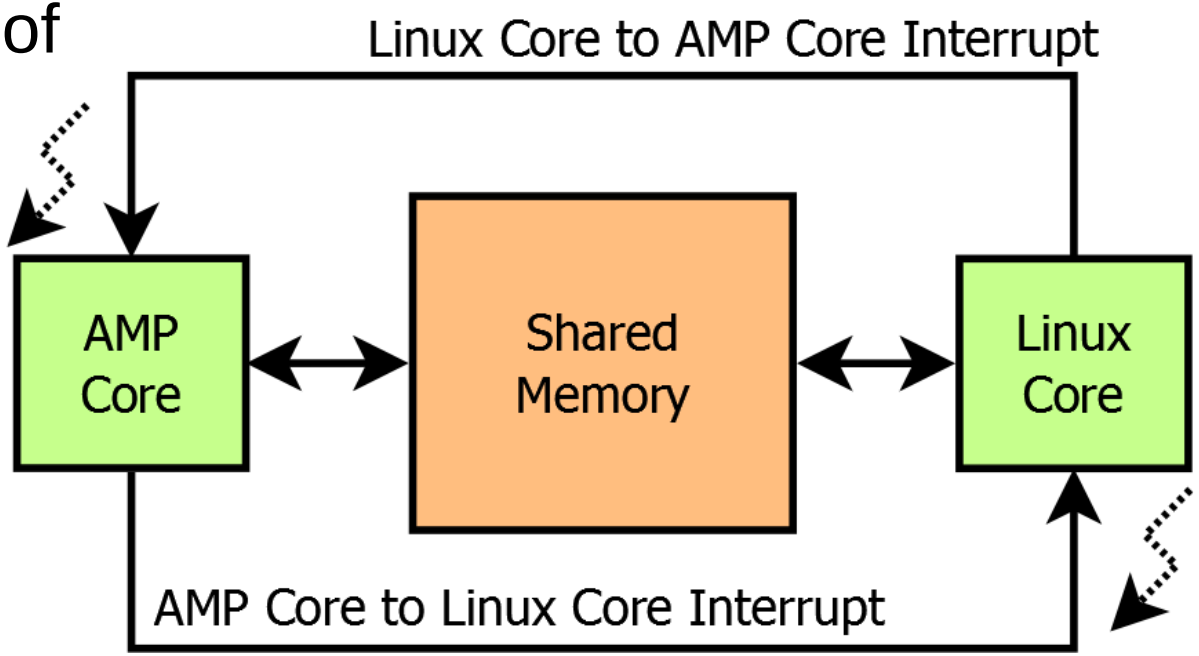
- Thanks to AMP, your system can:
  - Be faster
  - Consume less power
  - Be safer
  - Be more secure
- How?

Motivation – why AMP? 2/2

- Not all CPUs in the system are treated equally
- The cores can:
  - Run independently
  - Have different operating systems
  - Have different architecture, clock frequency
  - Be tailored for a specific task (DSP)

How does it work?

- There is a concept of master and slave
- Master manages shared memory
- Master may control slave's life-cycle



Remote Processor Messaging (RPMsg) in Linux kernel

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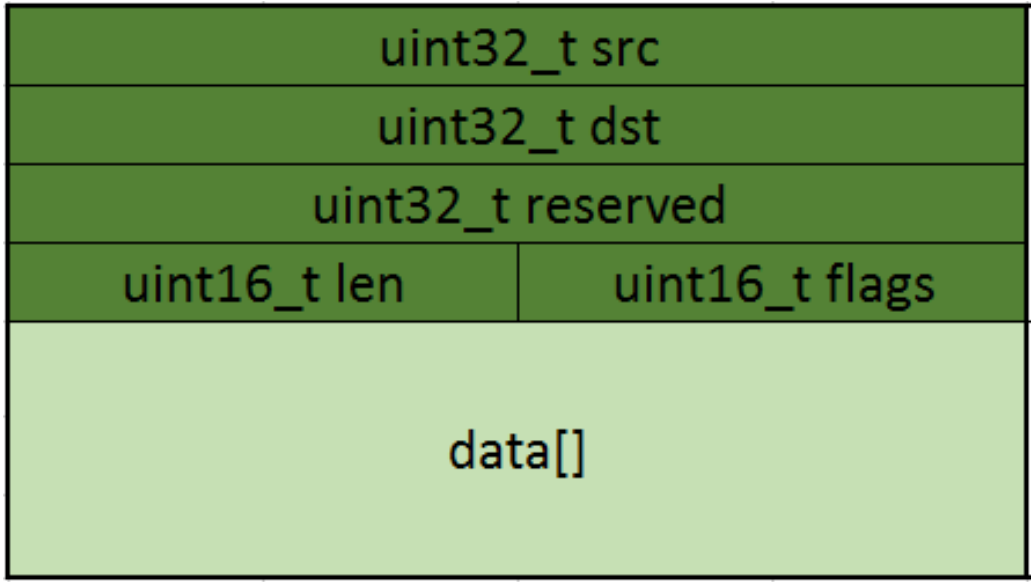
What is RPMsg?

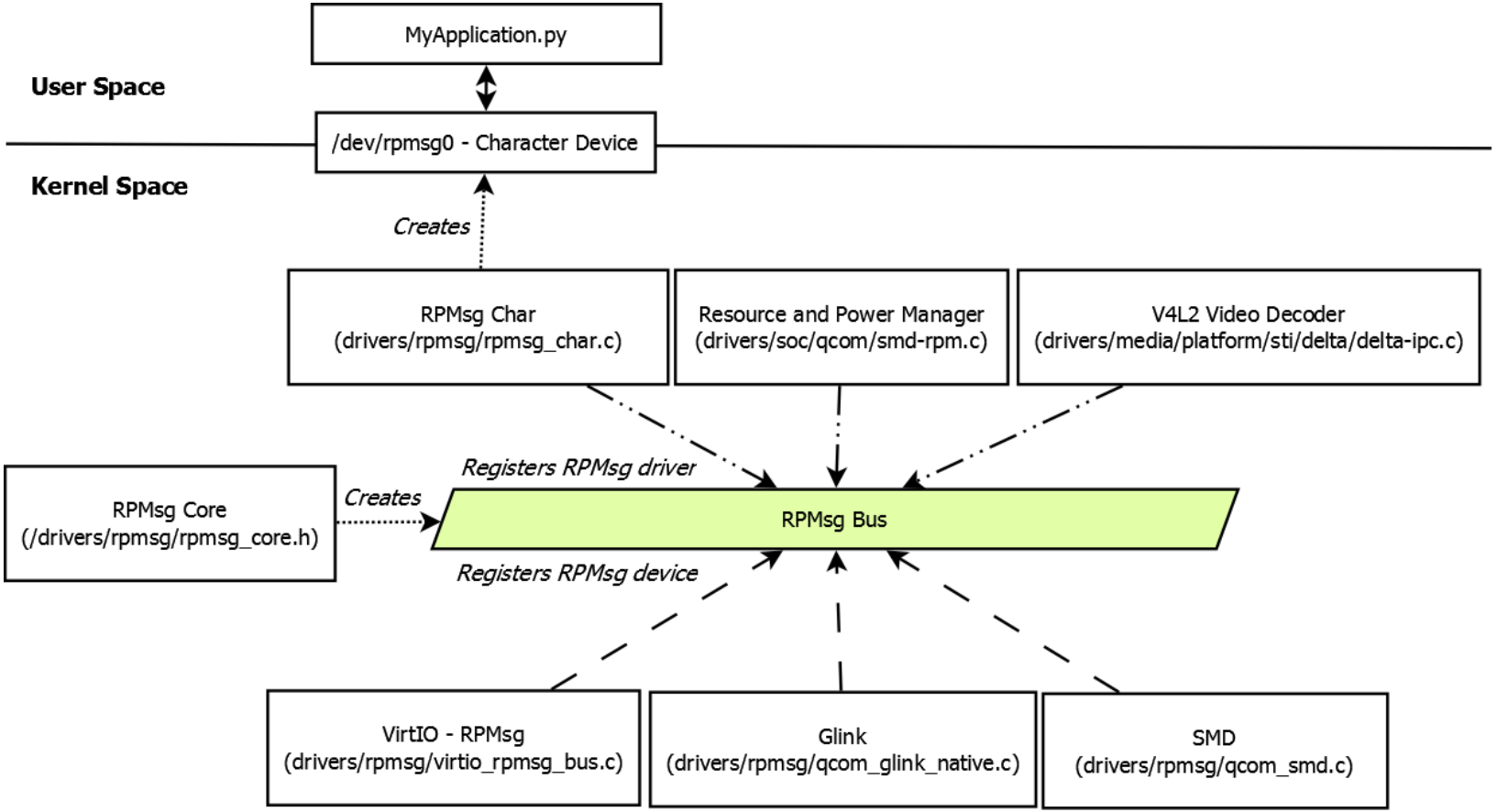
- RPMsg defines a UDP-like header
- Only the header is strictly defined, there exist multiple transport mechanism



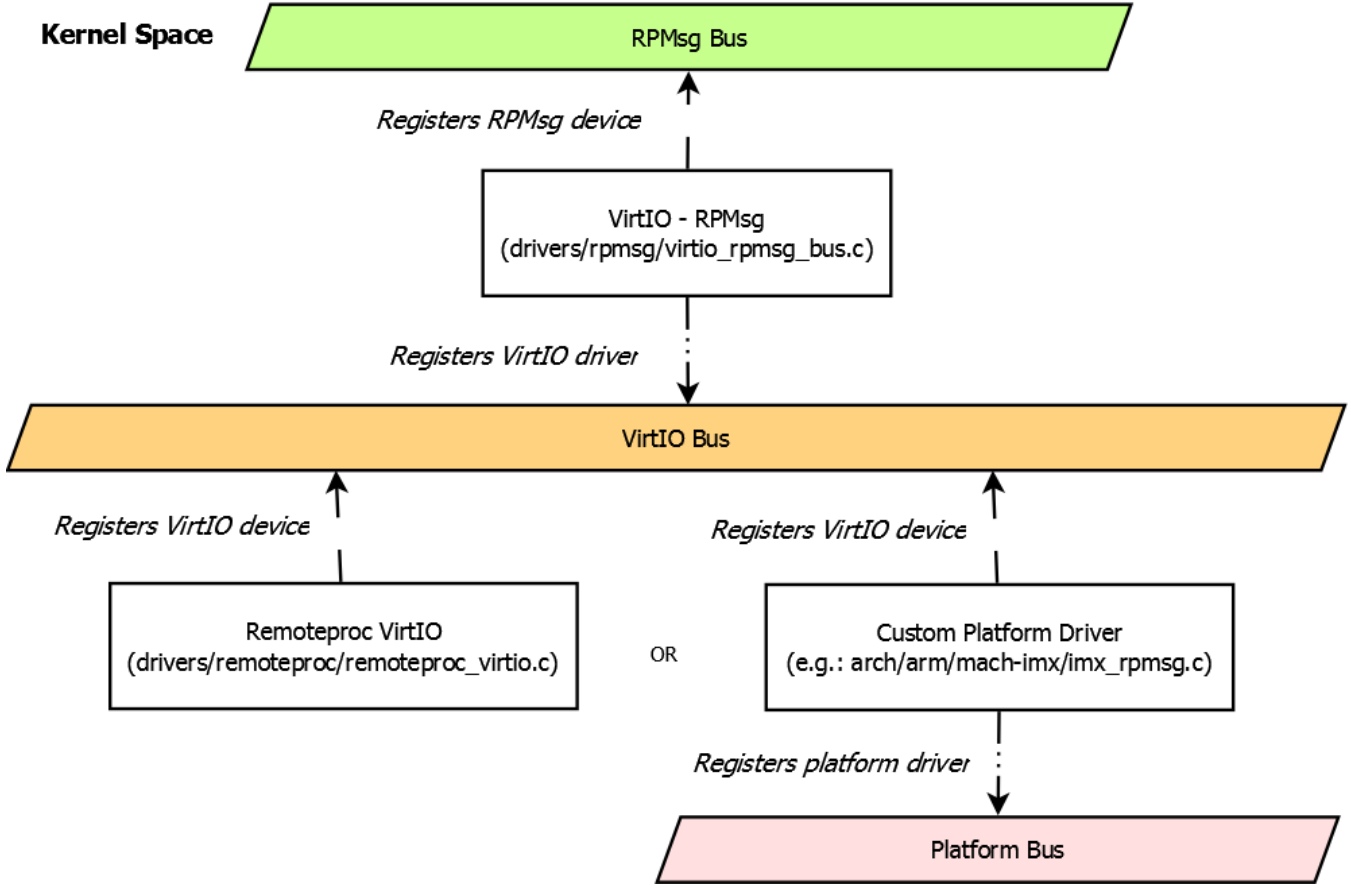
RPMsg in Linux - History

- RPMsg used to have only one transport layer based on VirtIO
- Initially maintained by Ohad Ben Cohen
- Now maintained by Bjorn Andersson (Linaro)
- New transport layers added – Glink and SMD
  - Mostly for Qualcomm platforms

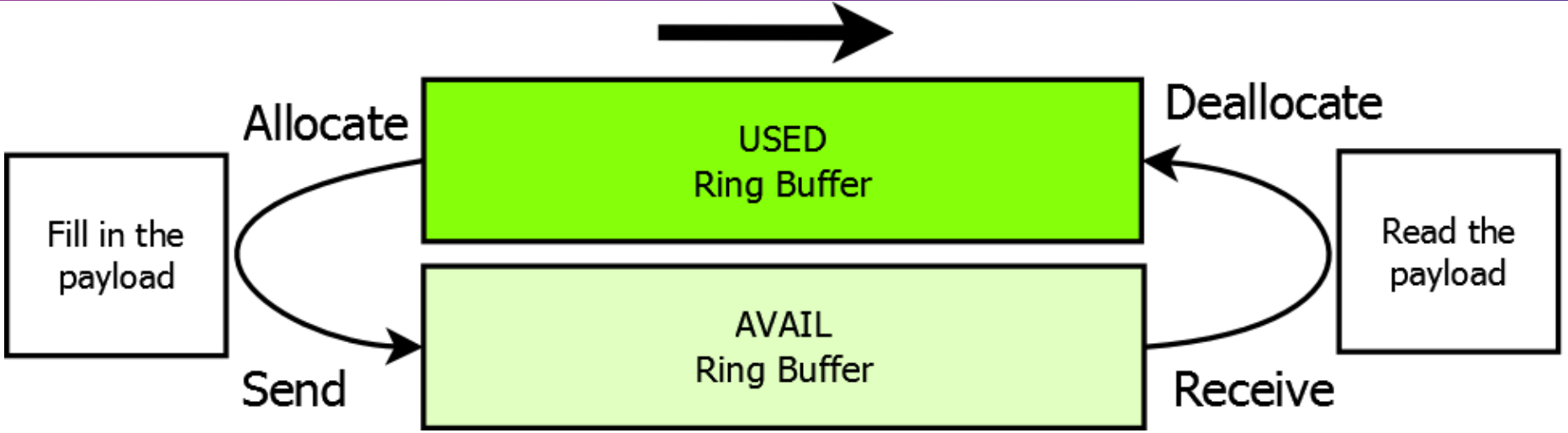
RPMsg in Linux – Current State 1/2



RPMsg in Linux – Current State 2/2

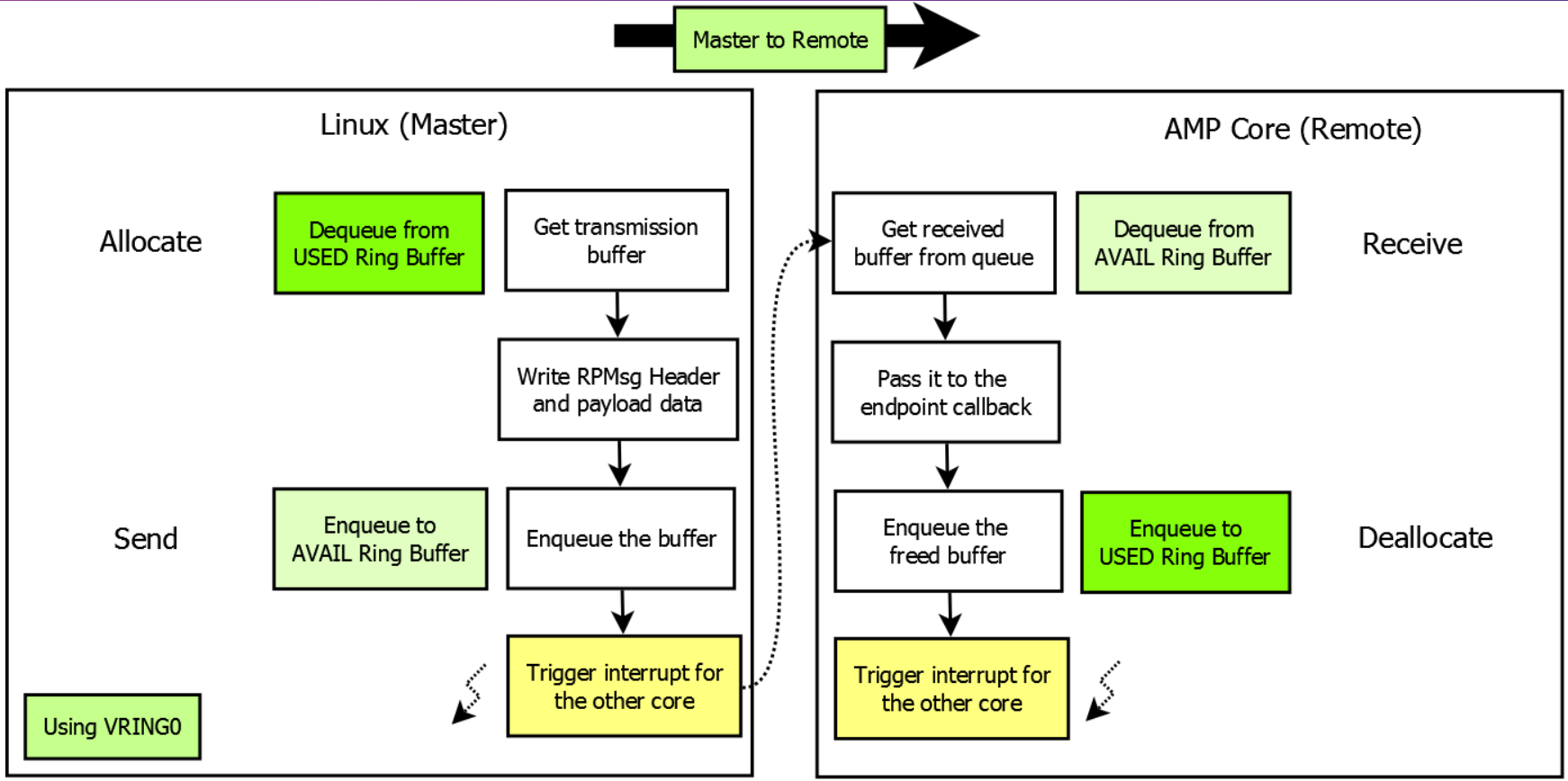


RPMsg/VirtIO 1/3

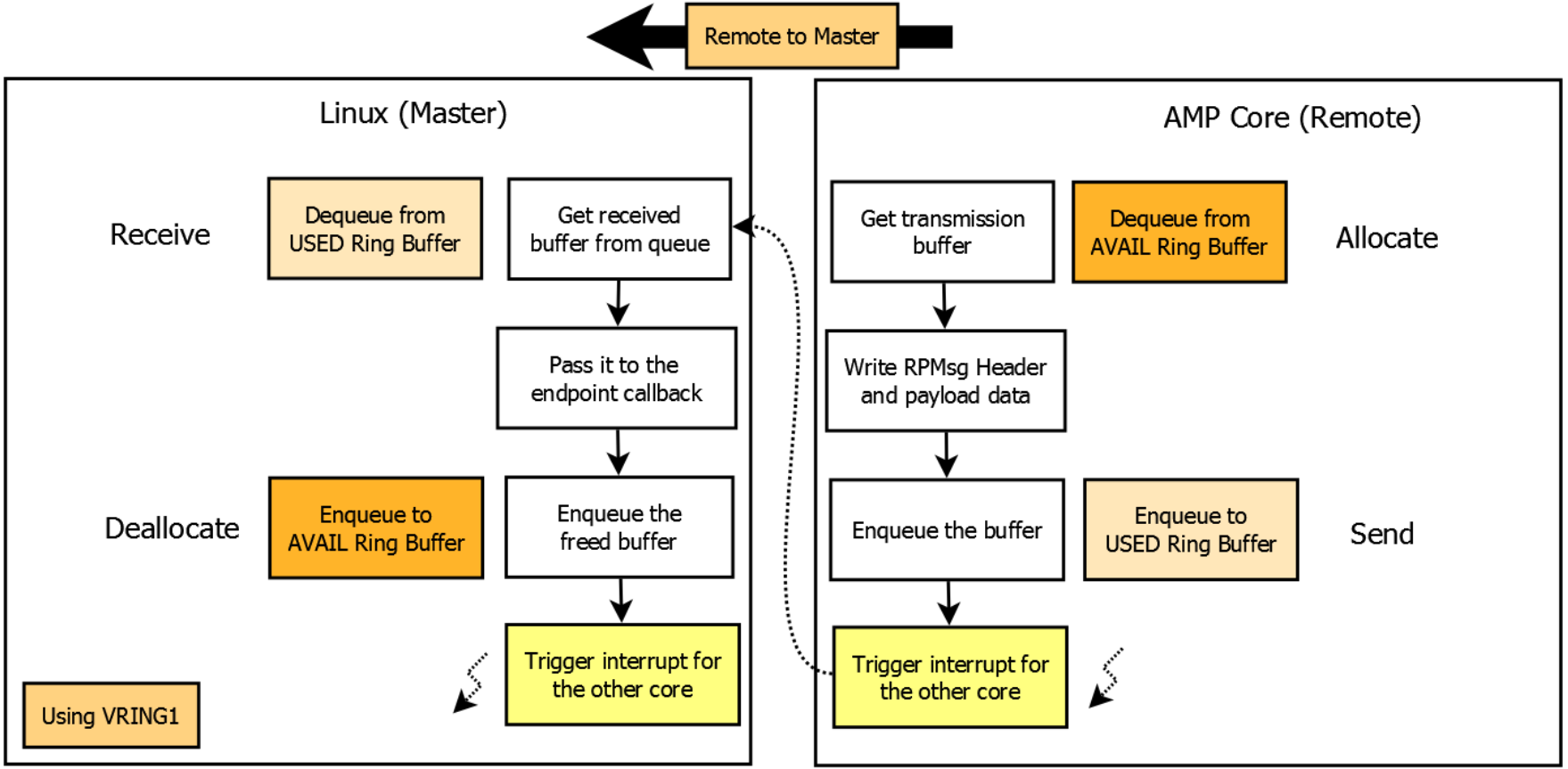


- Single writer single reader approach
- Allows for zero-copy
- 2 ring buffers for each direction

RPMsg/VirtIO 2/3



RPMsg/VirtIO 3/3



RPMsg-Lite – RPMsg for RTOS

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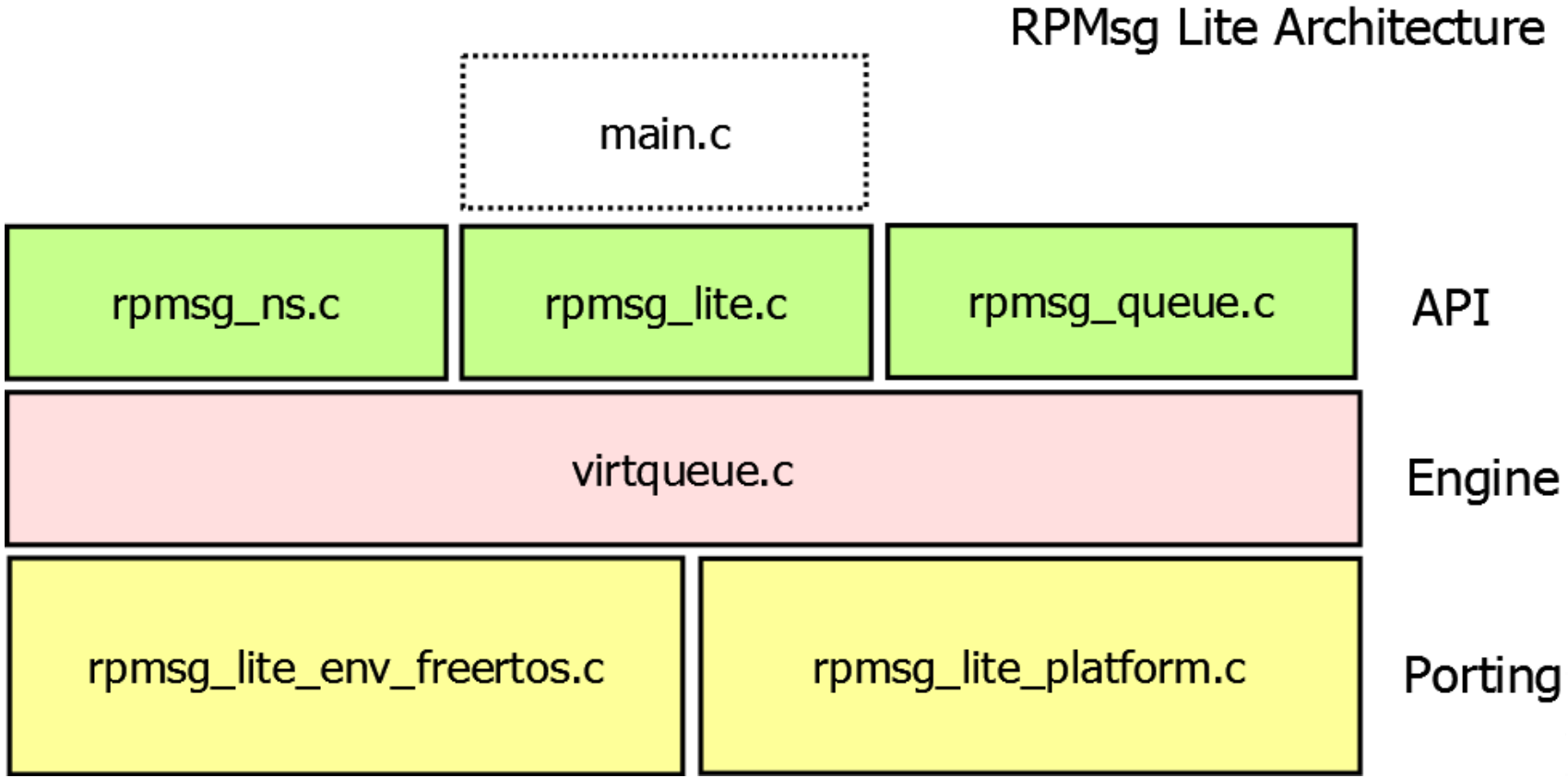
Library Architecture 1/2



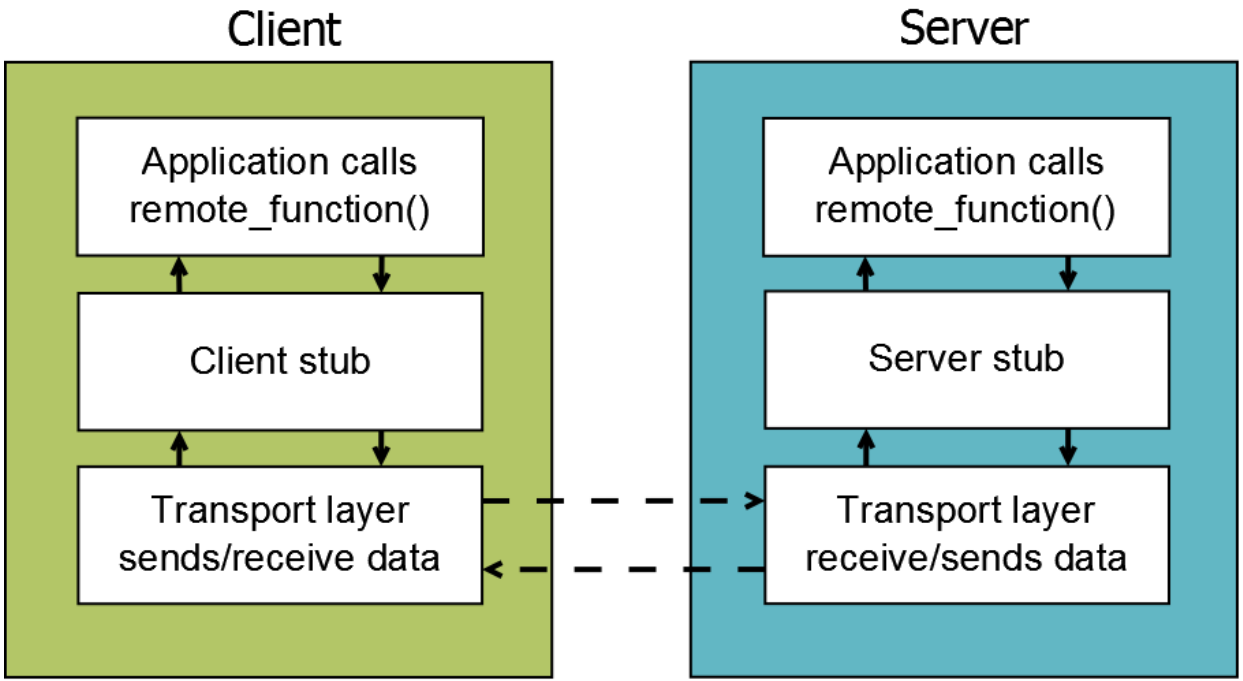
Library Architecture 2/2

- Environment (“RTOS”) porting layer
- Platform (“hardware”) porting layer
- Modular and simple
- BSD licensed
- FreeRTOS port (done) and Zephyr port (TBD)
- Github: https://github.com/NXPmicro/rpmsg-lite

Embedded Remote Procedure Call (eRPC)

- What is RPC?
- Why eRPC?
- How to use eRPC?

What is RPC?

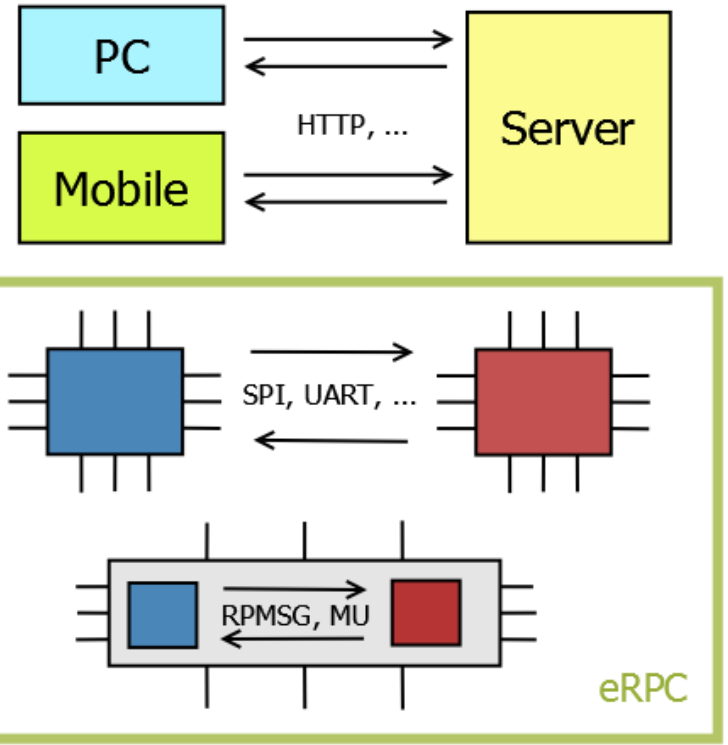


Why eRPC? 1/2

WEB, ...

Embedded multiprocessor

Embedded multicore



Other RPC:

- Apache Thrift
- Microsoft RPC
- Google RPC
- JSON-RPC
- ...

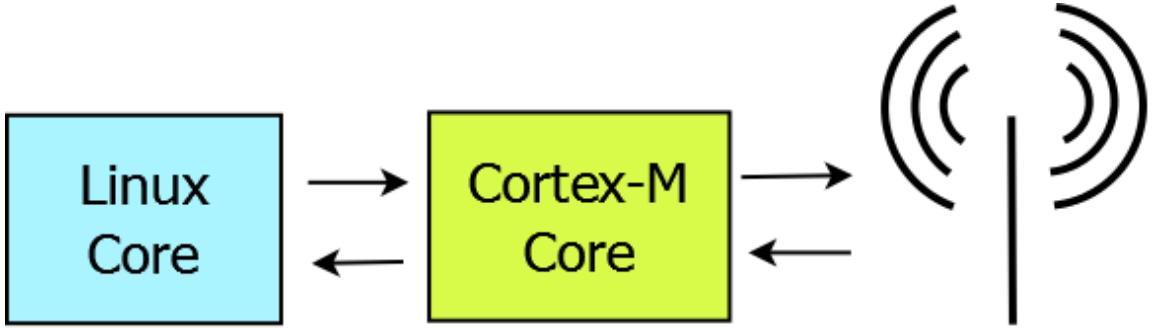
Why eRPC? 2/2

- Small code size
- Programing languages: C/C++, Python, … ?
- APIs style defined by user.
- Generated stub code
- Easy to port: BM, FreeRTOS, Zephyr(TBD)
- Modular and simple
- BSD-3: https://github.com/EmbeddedRPC/erpc

How to use eRPC? 1/3

Dual core device – Linux core + Cortext-M core

- Main core – Multimedia applications, web server, …
- Second core – communicating through radio



How to use eRPC? 2/3

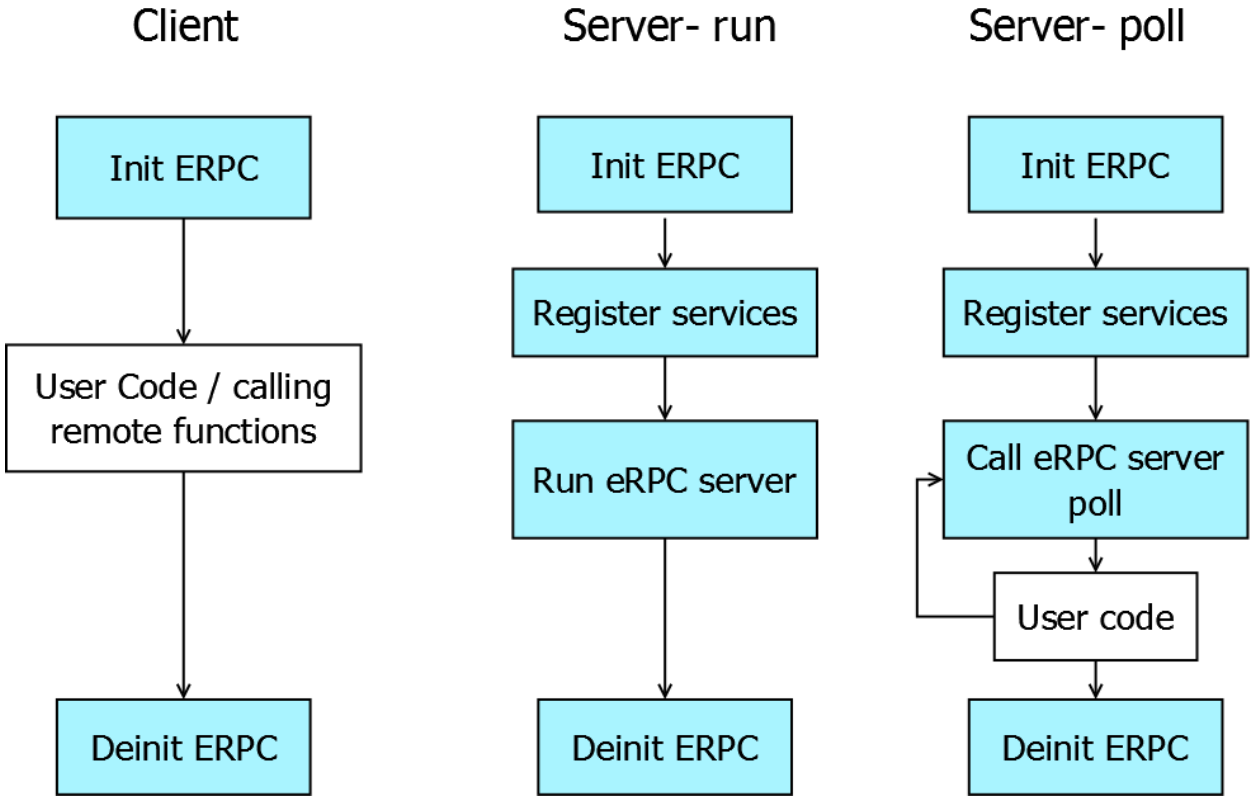
- Interface Definition Language (IDL):

```
interface Radio {
    send_packet(uint16 addr, uint8 dataLength,
                binary data @length(dataLength)) -> bool
}
```

- Generated declaration:

```
bool send_packet(uint16_t addr, uint8_t dataLength,
                 const uint8_t* data);
```

How to use eRPC? 3/3



Q & A

- RPMsg-Lite: https://github.com/NXPmicro/rpmsg-lite
- Marek NOVAK: marek.novak@nxp.com
- eRPC: https://github.com/EmbeddedRPC/erpc
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Embedded Linux Conference

Europe

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