BKK19 OpenAMP
Shared Memory for Large Data

Following slides contain some useful links and resources. Any questions, please email marketing-team@linaro.org
Large Data Shared Memory Issues in OpenAMP

- huge data memory allocation
  - Accessible by both application and coprocessor
  - Zero copy
- memory address mapping for coprocessor
- memory synchronization
Huge Data Shared Memory Use Cases

- Shared memory is statically-defined
Huge Data Shared Memory Use Cases

- Shared memory is from the application processor system memory
Huge Data Shared Memory Use Cases

- Shared memory is from the application address space
Libmetal Shared Memory Abstraction

Applicaiton

Libmetal

OS Environment

Device

Memory

metal_shmem_open()
metal_shmem_attach()
metal_shmem_sync
Libmetal Shared Memory Abstraction

- `metal_shm_open()` – allocate shared memory if it is not allocated
- `metal_shm_attach()` – attach shared memory to device, mmap the memory for the device driver, allocate locks, etc.
- `metal_shm_sync_for_cpu()` – stop device shared memory access, and allow CPU access.
- `metal_shm_sync_for_device()` – stop CPU shared memory access, and allow device access.
Libmetal Shared Memory Abstraction With RPMsg and Remtoeproc Option

- **RPMsg**: Remote Processor Messaging
  - Pass shared memory information to coprocessor
  - Memory sync
- **Remtoeproc**: Manage coprocessor resources
  - Coprocessor shared memory management
    - Only remoteproc knows about the device address of the shared memory
  - Low level IPC (notification)
Libmetal Shared Memory With Remoteproc in Linux – DMA buf

**Application**
- `metal_shm_open()`
- `metal_shm_attach()`
- `metal_shm_sync`

**libmetal**
- DMA buf fd
- va, dev_addr

**Coprocessor**
- dev_addr, size
- `Sync_r/Sync_w, Ack`

**Linux Kernel**
- Allocator (ION...)
- Remoteproc ioctl to import DMA buf
- DMA buf
- RPMsg

**Shm size**
- DMA buf fd
RPMsg for Shared Memory Sync

App A

rpmsg_sync(da, len, w_req)

RPMsg SHM Endpoint A

RPMsg(req_w, da, len)

RPMsg(ack_w, da)

RPMsg SHM Endpoint B

callback(req_w, da, len)

rpmsg_sync(ack_w, da)

rpmsg_sync_resp(callback)

App B
Libmetal Shared Memory With Remoteproc in Linux – IOMMU

Application

Libmetal

mmap()

RemotePROC ioctl to do DMA mmap

Coprocessor

dev_addr, size
Sync_r/Sync_w, Ack

Linux Kernel

shm size
va, size
dev_addr

dev_addr, size
Sync_r/Sync_w, Ack

metal_shm_open()
metal_shm_attach()
metal_shm_sync

va,

size

va,
Libmetal Shared Memory With Remoteproc in Linux – Remoteproc Static Shared Memory

**Application**

- `metal_shm_open()`
- `metal_shm_attach()`
- `metal_shm_sync`

**Coprocessor**

- `dev_addr, size`
- `Sync_r/Sync_w, Ack`

**Linux Kernel**

- `Remoteproc ioctl to do DMA allocation`
- `DMA buf`
- `RPMsg`

**Libmetal**

- `dma_buf fd, va, dev_addr`
- `shm size`

**Functions**

- `remoteproc_ioctl` to do DMA allocation
- `metal_shm_open()`
- `metal_shm_attach()`
- `metal_shm_sync`
Remoteproc Carveouts

- virtual address
- DMA address
- Len
- Device address
Open Questions

- Is there a way for a RPMsg device to know about its attached remoteproc device?
  - Remoteproc can verify the shared memory and returns the remote address mapping.
- Userspace remoteproc and RPMsg?
Thank you

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