DPDK

DATA PLANE DEVELOPMENT KIT

Exploring the New DPDK Memory Subsystem

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DPDK Is No Longer As Greedy!

- DPDK can now allocate hugepage memory as needed
- DPDK can also release memory that is unused
- DPDK can put pages into fewer files
    - Small page sizes and virtio are not enemies anymore!
- (18.08+) DPDK no longer requires a hugetlbfs mountpoint

Looking Inside

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What Changed in 18.05?

Main design goal:

Ability to map/unmap hugepages at runtime, not just startup

Everything else is side effect and/or practical necessity!

Memory Rework Design Principles

Question:

- How do you keep IOVA-contiguous memory without pre-sorting pages?

Answer:

- You don’t!
  - In 18.05, we deal with *pages*, not *segments*
  - Memory is no longer guaranteed to be IOVA-contiguous

Memory Rework Design Principles

Question:

- What if you need IOVA-contiguous memory?

Answer:

- Chances are, you *actually* don’t…
- Ask for it!
  - Normal malloc API’s will not allocate IOVA-contiguous memory
  - Memzone allocator has a flag to request IOVA-contiguous memory
- Use VFIO for everything
- Use legacy mode

Memory Rework Design Principles

Question:

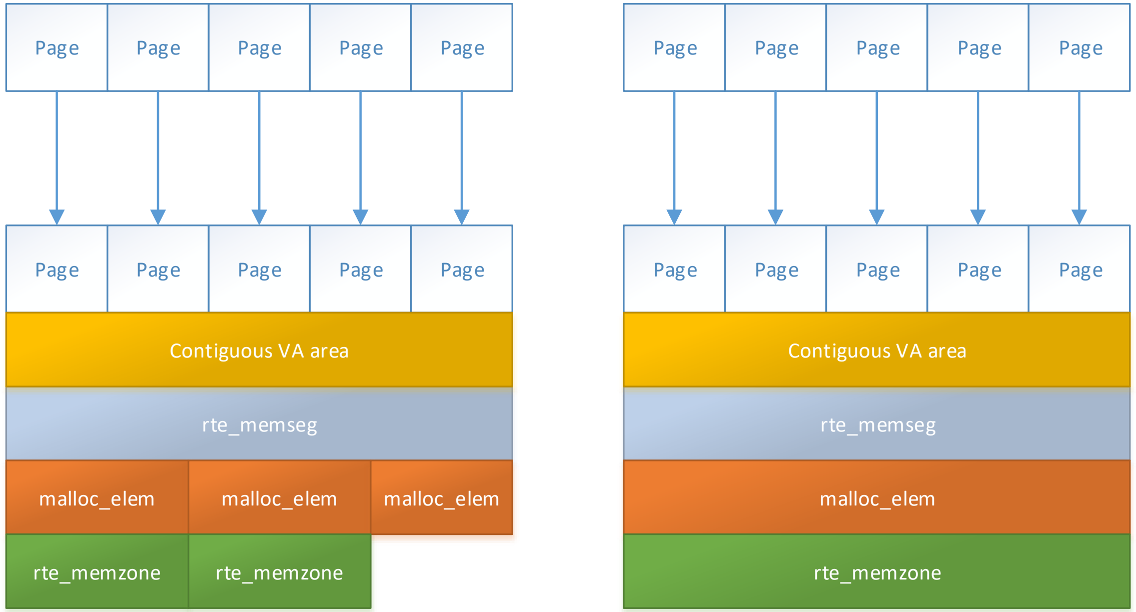
- How do we guarantee secondary process has the same view of memory?

Answer:

- Preallocate all VA space at startup!
    - Page table are synchronized over DPDK IPC
    - Primary has authority over what pages get used

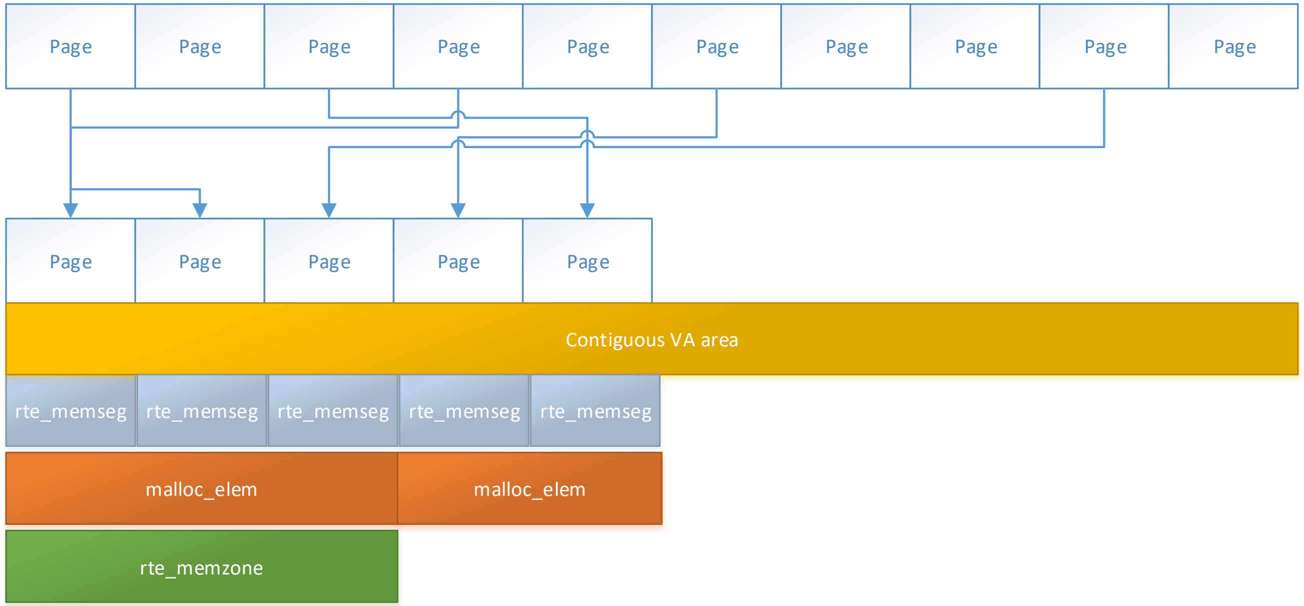
Legacy DPDK Memory Architecture

- VA layout follows PA layout
- VA and PA layout is fixed



18.05+ DPDK Memory Architecture

- VA layout is independent from PA layout
- VA layout is fixed, PA layout is not



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Shiny New Stuff

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Changes & New Features in 18.05+

New API’s:

- New memzone flag:
  - RTE_MEMZONE_IOVA_CONTIG
- Memory event and validation callbacks
  - Page map/unmap events
  - Allow/deny new page mappings over specified limit
- Page walk and lookup API’s
  - rte_memseg_walk et al.

Changes & New Features in 18.05+

EAL parameters:

- -m/--socket-mem is now a **minimum**, not a **limit**
  - Think guaranteed memory availability
- --single-file-segments
  - Creates fewer hugepage files
- --legacy-mem
  - Mimics old DPDK
- --limit-mem (18.08+)
  - Place upper limit on memory usage, per socket
- --in-memory (18.08+)
  - Run without hugetlbfs mountpoint

Future Changes (18.11+)

External memory support

- Currently RFC, V1 will be submitted for 18.11
- Using normal DPDK allocators with non-DPDK memory!

Memfd hugepages support for --in-memory mode

- Allows running without hugetlbfs *and use virtio/vhost*
  - Patches currently at V1
  - Virtio patches currently RFC
- Makes DPDK easier to set up in Cloud Native environments

Case Studies

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Why You Should Care

Generally, memory in DPDK is designed to be invisible, so why should anyone care?

- Because we can accidentally break stuff!

When changes happen, certain things may break because:

- Code makes assumptions about memory layout
- Code makes assumptions about internals of DPDK

Memory management is fundamental to DPDK, so changes in memory subsystem can potentially affect everyone!

- Call for more reviews of memory-related patches

Memory Layout Dependency

Problem:

- Certain drivers in DPDK relied on PA layout for lookups
  - Few memsegs to look through => little impact on performance
- After applying 18.05 memory hotplug changes, there was a noticeable performance drop

Solution:

- For affected drivers, stopgap solution was implemented for 18.05
  - Performance still impacted for small page sizes
- Proper solution expected for 18.11

Memory Layout Dependency

Problem:

- net/virtio relies on valid memory starting from offset 0 into page table
- A patch to 18.08 made it so that segments are allocated from the top of VA space
- As a result, net/virtio had issues trying to share more memory than was needed

Solution:

- Reverted the patch for 18.08
- Investigation still ongoing

Q&A

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