DELIVERABLES

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1. MMIO with and without interrupts - done
2. DMA with and without interrupts - done.
3. Multiprocessing/Mutithreading and multiple cdev - done.
4. mmap - NOT done.

DESIGN & IMPLEMENTATION:

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1. USER LIBRARY

a. The user library handles all the work of encrypt/decrypt and setting keys per cdev. Kernel driver gives read and write syscall to the user which behaves differently for different offset provided by the user library. UserLib is responsible for correct sequence of encrypt/decrypt data and registers read/write procedure.

b. The userlib maps an array of struct key mapped to cdev. The user ensures to set key before each encrypt/decrypt.

c. The userlib breaks the data into 4KB chunks and call the encrypt/decrypt serially. Though buffer was increased to 2 MB in the a new commit. 4KB was chosen for the safe-side as the qemu failed to compile for me, and I was a little skeptical to increase the size without applying the patch.

d. The userlib puts a lock if a thread wants to encrypt/decrypt to prevent any incorrect behaviour of critical section of read/write to deice buffers/registers.

e. use of sysfs variable isDMA and isInterrupt for setting global config.

2. KERNEL DRIVER

a. kernel driver uses a character device to communicate with user library.

b. CryptoSys class for sysfs. It implements isDMA and isInterrupt variable for decision making through user space.

c. character read-write are dependent on offset. Sense of what user library wants to do is made using offset.

d. dma_zalloc_coherent is used for coherent dma and design decision was to choose between streaming(dma_map_single) vs coherent.

e. wait_queue for sleeping and wake_up when interrupt occurs.

f. the copy_to_user and copy_from_user functions are called for transfer of buffer.

g. Readl, writel, and readq and writeq are used for writing to registers. Interrupt handler checks IRQ_STATUS for identifying interrupt.

3. TESTING:

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1. Use of printf and printk to correctly identifying the path flow of required functionality. Reading logs for ensuring correctness.
2. Design of test-cases scenarios:(permutation of {DMA,INTERRUPT}X{SET,UNSET})
    a. Testing 2 device handles with different pairs of keys coexisting simultaneously and encrypt/decrypt calls are mixed interchangeably.
    b. Testing it for small data buffers(<4096Bytes) and large buffers(>4096 Bytes) and very large buffers(1MB generated using benchmarks create-dev). using `diff` for output comparison
    c. running two test executables simultaneously using & in the shell and verifying the ouptut.(though not a good test)

BENCHMARKS

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1. **DMA**

Linux 4.19.13 (tos-Standard-PC-i440FX-PIIX-1996) Monday 02 March 2020 _x86_64_ (2 CPU)

09:11:45	IST	CPU	%user	%nice	%system	%iowait	%steal	%idle
09:11:47	IST	all	2.51	0.00	47.74	0.00	0.00	49.75
09:11:49	IST	all	3.00	0.00	47.25	1.00	0.00	48.75
09:11:51	IST	all	3.02	0.00	47.24	0.00	0.00	49.75
09:11:53	IST	all	2.50	0.00	47.75	0.00	0.00	49.75
09:11:55	IST	all	3.02	0.00	47.24	0.00	0.00	49.75
Average:		all	2.81	0.00	47.44	0.20	0.00	49.55

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2. **DMA WITH INTERRUPT**

Linux 4.19.13 (tos-Standard-PC-i440FX-PIIX-1996) Monday 02 March 2020 _x86_64_ (2 CPU)

09:13:19	IST	CPU	%user	%nice	%system	%iowait	%steal	%idle
09:13:21	IST	all	0.00	0.00	0.25	0.00	0.00	99.75
09:13:23	IST	all	0.00	0.00	0.50	10.00	0.00	89.50
09:13:25	IST	all	0.00	0.00	0.25	0.00	0.00	99.75
09:13:27	IST	all	0.25	0.00	0.25	0.00	0.00	99.50
09:13:29	IST	all	0.00	0.00	0.25	17.84	0.00	81.91
Average:		all	0.05	0.00	0.30	5.56	0.00	94.09

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3. MMIO

Linux 4.19.13 (tos-Standard-PC-i440FX-PIIX-1996) Monday 02 March 2020 _x86_64_ (2 CPU)

09:14:38	IST	CPU	%user	%nice	%system	%iowait	%steal	%idle
09:14:40	IST	all	6.91	0.00	70.21	0.00	0.00	22.87
09:14:42	IST	all	5.99	0.00	70.84	3.27	0.00	19.89
09:14:44	IST	all	5.46	0.00	70.77	0.00	0.00	23.77
09:14:46	IST	all	6.35	0.00	69.05	2.91	0.00	21.69
09:14:48	IST	all	6.23	0.00	72.52	0.00	0.00	21.25
Average:		all	6.20	0.00	70.65	1.25	0.00	21.90

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4. MMIO WITH INTERRUPT

Linux 4.19.13 (tos-Standard-PC-i440FX-PIIX-1996) Monday 02 March 2020 _x86_64_ (2 CPU)

09:17:02	IST	CPU	%user	%nice	%system	%iowait	%steal	%idle
09:17:04	IST	all	0.00	0.00	0.50	0.00	0.00	99.50
09:17:06	IST	all	0.00	0.00	0.75	1.26	0.00	97.99
09:17:08	IST	all	0.00	0.00	0.25	3.27	0.00	96.48
09:17:10	IST	all	0.00	0.00	0.50	0.00	0.00	99.50
09:17:12	IST	all	0.00	0.00	0.75	0.00	0.00	99.25
Average:		all	0.00	0.00	0.55	0.90	0.00	98.54

MMAP AND MMAP WITH INTERRUPT NOT DONE
