

CS 537: Intro to Operating Systems (Fall 2017)

Worksheet 5 - Memory Virtualization II

Due: Oct 11th 2017 (Wed) in-class OR email to Simmi before 5:30 pm

1. Reverse Engineering of Page Table

Assuming dynamic relocation is performed with a linear page table, then given the page table, we can translate the virtual address to physical address. Now let's try to reverse the process, i.e. given a series of VA-PA translation, reconstruct some entries of the page table.

Virtual Address	Physical Address
0x0000c17c	0x003a017c
0x00009e4d	0x00137e4d
0x00004021	Invalid
0x0000e8e5	0x001208e5
0x0000fb97	0x00121b97

The page table entry is formatted in 32 bits and the high-order (left-most) bit is the valid bit. Therefore, you should represent the page table entry in the **32-bit hexadecimal format**, e.g. 0x8000019e, for the valid entry. If the entry is not valid, fill in 0x00000000. If the entry cannot be determined from this translation table, fill in "TBD".

(a) Assuming there are **16 entries** in the page table.

i. What is the minimum page size?

ii. Construct the page table with this page size

VPN	Entry	VPN	Entry
0		8	
1		9	
2		10	
3		11	
4		12	
5		13	
6		14	
7		15	

- iii. Assuming the TLB is initially empty and if these 5 virtual addresses in the translation table are accessed by the program sequentially, will there be any TLB hit? If so, list the VPNs that cause a TLB hit.

(b) Assuming there are **8 entries** in the page table.

- i. What is the minimum page size?

ii. Construct the page table with this page size

VPN	Entry	VPN	Entry
0		4	
1		5	
2		6	
3		7	

- iii. Assuming the TLB is initially empty and if these 5 virtual addresses in the translation table are accessed by the program sequentially, will there be any TLB hit? If so, list the VPNs that cause a TLB hit.

2. TLB

Assume a system with a simple linear page table and a hardware managed TLB.
Parameters:

- Virtual address space size = 64 bytes
- Physical memory size = 128 bytes
- Page size = 16 bytes

Let's assume we have an array of **ten 4-byte integers** in memory, **starting at virtual address 0x10**. Let's further assume that we access all the elements in the array, sequentially, starting at array index 0. The references to these array elements are the only memory references that we are interested in. Let's also assume the TLB was initially empty before accessing the array.

- For each element that is accessed in the array, write if it's a **TLB Hit (H)** or a **TLB Miss (M)**. (e.g. HMMHMHMMHM)

- What is the **TLB hit ratio** for accessing the entire array?

- If the page size is increased from 16 bytes to **32 bytes**, for each element that is accessed in the array, write if it's a **TLB Hit (H)** or a **TLB Miss (M)**. (e.g. HMMHMHMMHM)

- What is the **TLB hit ratio** for accessing the same array with the page size of 32 bytes?

3. Multilevel Page Table

Assume a system with a 2-level page table.

Parameters:

- page size = 32 bytes
- virtual address space size = 32 KB
- physical memory size = 4 KB
- Size of one Page Directory Entry (PDE) = 1 byte
- Size of one Page Table Entry (PTE) = 1 byte
- Value of Page Directory Base Register (PDBR) = **122** (decimal) [This means the page directory is held in this page]

The **format** of the **PDE** and the **PTE** is simple. The **high-order (left-most) bit** is the **VALID** bit. If the bit is 1, the rest of the entry is the PFN. If the bit is 0, the page is not valid.

You are given two pieces of information to begin with. First, you are given the value of the page directory base register (**PDBR**), which tells you which page the page directory is located upon. Second, you are given a **complete dump of each page of physical memory** in the next 2 pages. A page dump looks like this:

```
page 0: 1d 1d 06 08 05 00 0e 10 ...
page 1: 16 1b 14 19 00 1d 16 12 ...
page 2: 7f 7f 7f 7f 7f 7f 7f 7f ...
...
```

which shows the 32 bytes found on pages 0, 1, 2, and so forth. The first byte (0th byte) on page 0 has the value 0x0d, the second is 0x0f, the third 0x06, and so forth. For each **virtual address**:

- write down the **physical address** it translates to AND the **data value** at this physical address, OR
- if it is a **segmentation fault** (an out-of-bounds address) write the **reason** for this segmentation fault (**Invalid PDE OR Invalid PTE**).

Write all answers in **hexadecimal**.

Virtual Address	Physical Address / Seg Fault	Data Value	Reason for Seg fault
0x21e1			
0x0325			
0x7570			
0x7a36			

Physical Memory Dump

```
page 0: 1d 1d 06 08 05 00 0e 10 1b 0e 05 0d 04 01 0c 19 02 1e 1a 1e 12 09 17 04 10 19 10 17 05 1a 04 0a
page 1: 16 1b 14 19 00 1d 16 12 1c 1b 03 19 17 06 17 12 05 18 04 12 0d 07 11 0e 06 1d 02 00 0f 19 14 17
page 2: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f bf 7f 7f 7f b5 dd 7f 7f ac 7f 7f 7f
page 3: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 4: 03 13 10 05 1d 1e 1b 0e 09 06 19 15 08 1b 11 0c 0c 16 0e 14 03 15 08 1c 06 0a 10 0c 10 1c 06 17
page 5: 15 0b 0d 17 06 08 10 1c 02 19 16 05 14 13 16 10 09 0f 07 0e 0c 03 07 0a 0c 11 17 08 11 0a 07 04
page 6: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 7: 19 16 14 09 12 12 12 04 0d 0c 16 1e 1d 10 0d 08 01 00 0e 09 0b 1b 10 11 07 00 0a 04 0f 1e 14 05
page 8: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 9: 7f 7f 7f 7f 7f 7f 7f 7f bc 7f 7f 7f 7f 7f 7f 7f 7f c4 7f 7f 7f 7f 7f 7f 7f 7f 7f a9 7f 7f 7f 7f
page 10: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 87 7f c3 7f 7f 7f 7f e6 7f 7f 7f 7f f7 7f 7f 7f 7f 7f 7f 7f 7f
page 11: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 12: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 13: 13 06 0b 09 0d 0d 0c 18 19 11 0e 08 17 1e 07 15 15 14 00 11 06 06 11 13 13 17 15 0e 01 17 19 19
page 14: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 15: 09 08 1e 1d 14 0d 0c 02 0e 04 10 19 0c 15 19 1c 0d 07 1b 0f 08 15 1a 1e 0b 08 07 09 06 1c 13 01
page 16: 12 0e 06 01 0a 18 04 07 13 13 18 13 1a 04 1c 00 03 03 18 0f 1c 1e 1d 13 0a 1d 16 06 11 00 00 13
page 17: 06 15 00 02 18 06 05 0c 19 00 1b 09 11 0e 03 1d 05 18 1b 0e 1d 01 04 0e 02 19 10 18 08 00 1b 06
page 18: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 19: 7f 7f 7f 7f 7f 9b 7f 7f 7f 7f 7f 7f 7f 7f 7f c1 af 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 20: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 21: 05 14 0e 0a 02 01 08 02 15 06 0b 0d 15 19 13 06 04 11 0b 16 06 15 0b 08 05 17 0f 10 19 00 10 0a
page 22: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 23: 06 10 0e 09 13 06 1c 1d 16 0d 0f 12 01 0c 10 05 02 18 0b 10 1c 12 08 1e 0b 00 15 03 09 1a 14 00
page 24: 0b 18 07 19 13 0c 19 0a 1b 1c 0f 15 1d 17 17 1a 1d 17 1e 09 13 14 0b 0c 05 1d 0a 0e 1b 05 1d 03
page 25: 7f 7f 7f cb 84 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 91 7f 7f 7f 7f 7f 7f 7f ef 7f 7f
page 26: 1b 1e 04 11 04 1b 1a 1c 17 0c 13 01 03 11 16 09 00 01 0a 0b 1c 15 1b 17 15 17 06 17 12 13 0f 0d
page 27: 06 10 19 02 1d 14 01 15 0c 0f 03 0f 10 18 12 15 16 06 00 0e 04 04 09 10 13 14 1d 03 11 02 14 0d
page 28: 12 05 09 19 11 16 0e 08 0f 11 07 1a 1e 05 07 19 16 06 12 07 1a 12 0f 05 0c 0e 0b 05 06 15 1c 1a
page 29: e7 7f db 7f 7f 7f 97 7f 8f 7f 7f 7f 7f 7f 7f a2 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 30: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 31: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 32: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 33: 0c 0d 04 09 00 0f 13 1e 1d 0a 1d 93 04 10 15 12 01 0c 0f 0b 17 17 02 0e 15 18 14 1e 16 0c 19 12
page 34: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 35: 15 0c 0d 16 14 04 13 01 06 19 1c 07 17 05 0f 0a 02 0d 11 1a 03 08 00 06 08 19 1d 06 0e 10 0f 1d
page 36: 02 19 11 14 09 18 1d 1e 01 09 02 0e 14 12 0a 1d 13 1e 0d 13 03 10 14 07 13 04 0e 12 0e 04 05 0b
page 37: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 38: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 39: 14 0e 1d 0b 0a 1c 12 03 18 0b 1d 13 18 1b 0f 1d 00 0a 19 00 14 1e 16 1a 02 10 12 0d 0d 18 05 01
page 40: 0d 09 13 09 1c 19 09 02 00 19 0d 03 01 18 06 1c 0b 13 0a 14 04 08 03 01 11 1e 00 1b 08 04 00 0a
page 41: 00 1c 1b 0e 02 19 0f 0e 13 04 06 19 16 1e 0d 1e 1b 0f 1b 05 02 19 04 0f 16 15 06 18 01 11 1b 10
page 42: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f d6 7f 7f 7f 7f 7f 7f 7f a4 7f 7f 7f 7f 7f 7f 7f
page 43: 7f 7f 7f 7f 7f 7f 7f ec 7f 7f 7f 7f 7f 7f 7f a7 7f 7f 7f 7f 7f 7f d5 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 44: 0b 1c 1b 17 0d 10 07 19 0c 08 13 04 09 1c 02 04 06 07 0d 07 0a 07 07 12 0a 0b 17 01 04 1a 0d 18
page 45: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f f2 7f
page 46: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 47: 7f 7f 7f 7f 7f 7f 7f b1 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 98 7f 7f 7f 7f 7f 7f 9f 7f 7f 7f 7f 7f
page 48: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 49: 15 04 15 09 14 05 18 0c 19 1d 12 00 0b 1e 14 17 0e 1d 1c 12 12 03 00 06 16 1a 17 1b 00 00 07 00
page 50: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 51: 7f 7f 7f a5 7f c9 81 7f 7f 7f f2 1d ca 7f 7f ef 7f 7f 7f 85 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 52: 06 12 02 08 0b 1c 02 17 05 11 0c 0e 17 0c 03 03 02 1a 13 1d 15 00 14 18 16 0f 0b 0e 18 08 10 0e
page 53: 0c 1b 03 0f 19 0c 1d 07 0f 09 08 02 18 14 19 0e 05 14 1c 11 08 10 1a 19 13 16 00 04 00 0d 0f 00
page 54: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 55: 06 0a 09 04 12 0e 0a 00 1c 01 03 09 18 1d 17 06 1a 01 03 03 11 12 13 1d 17 17 05 1c 1c 19 02 16
page 56: 7f 7f 7f a8 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 57: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 58: 05 1b 12 17 07 16 15 18 05 1d 0e 02 1c 09 1b 06 02 0f 11 14 13 0b 17 0f 04 12 0a 10 04 07 08 14
page 59: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 81 7f 7f 7f 9c 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f b7 7f 7f 7f
page 60: 15 06 0c 16 08 13 01 15 07 0d 1e 18 05 18 0c 0f 08 05 1e 0c 06 18 03 0c 03 01 1e 0f 14 04 0b 01
page 61: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
page 62: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f c7 7f 7f 7f b4 7f 7f 7f 7f 7f 7f 7f d4 7f 7f 7f 7f 95 7f 7f 7f
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page 63: 10 13 1b 06 19 00 19 08 00 19 1e 14 18 0c 07 14 19 08 0b 08 08 1a 00 00 05 18 11 17 15 1b 12 00
page 64: 14 12 09 06 0f 1c 13 02 19 16 1c 05 17 01 14 08 07 1b 03 10 1a 07 06 1b 0d 16 00 0b 05 14 02 1d
page 65: 1d 08 12 0d 00 11 04 01 01 04 02 13 0f 1e 1c 1e 07 0d 07 12 13 18 15 07 0d 10 00 01 0c 03 16 07
page 66: 7f 7f a3 7f 7f e4 7f 7f 7f 7f f0 7f 7f 7f 7f 7f 7f 7f 7f c0 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 67: 14 10 19 03 0e 19 05 05 13 04 10 03 05 0a 18 12 12 13 0c 1e 12 13 02 07 12 1d 15 01 19 06 12 05
page 68: 08 17 19 17 09 16 02 15 00 00 03 14 1e 0e 13 12 1a 1e 19 0a 02 1b 08 17 1a 05 06 0d 1a 1a 1e 08
page 69: 01 18 1b 0d 0d 08 06 10 0d 14 14 06 17 0d 0c 05 12 15 18 19 0a 10 13 0c 00 16 1b 0e 1c 01 12 0c
page 70: 13 10 17 18 09 18 04 10 1c 06 1b 0f 16 04 01 07 12 1b 11 10 0b 0f 16 1a 0a 14 0a 07 01 0c 12 0f
page 71: 1d 0a 0d 17 09 18 0a 04 10 11 09 08 1e 0f 16 0d 11 08 05 19 15 09 0c 11 02 13 1e 15 0e 03 10 12
page 72: 00
page 73: 14 18 1b 14 14 0c 01 0e 03 1d 0b 12 16 05 19 0a 02 12 0c 1c 0d 02 00 00 0f 16 01 0a 0e 1b 1e 1b
page 74: 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 90 7f ea 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 75: 17 15 0e 18 0d 16 1c 10 04 1c 06 06 01 0d 0c 19 05 0b 17 00 0c 04 17 09 04 03 06 15 03 01 07 01
page 76: 00
page 77: 7f
page 78: 00
page 79: 00
page 80: 00
page 81: 00
page 82: 0c 1a 02 13 0c 10 1a 18 13 09 07 0e 07 08 1d 03 19 0b 0b 09 02 0e 05 0d 09 1b 1c 0d 13 1c 0a 03
page 83: 7f ff 7f d2 7f 7f 7f 7f 7f 7f 7f 7f
page 84: 11 10 0e 1d 17 0d 0f 1b 17 14 1d 03 12 13 0e 1d 1d 0c 13 17 15 0b 18 0a 04 14 14 0c 0f 1e 19 0c
page 85: 02 1e 14 01 1b 07 0e 11 04 0f 01 06 1c 19 10 15 1b 04 0f 04 03 03 06 01 06 0b 13 1a 1c 16 0f 1c
page 86: 08 0f 00 02 17 05 17 18 0c 14 18 1a 04 05 0b 0e 09 00 11 1d 0b 10 0b 0d 1a 09 14 0e 10 1c 02 19
page 87: 7f
page 88: 10 1a 1d 12 0d 10 18 14 18 09 12 07 11 00 10 16 1c 0f 1b 06 00 11 0a 0c 12 17 1a 0a 12 13 15 12
page 89: 1c 01 0a 0b 0c 1e 1e 19 14 18 1a 06 13 1e 05 0d 0b 1a 0e 04 0b 14 10 00 19 08 01 13 14 12 02 00
page 90: 00
page 91: 07 1b 0e 15 0c 1e 18 11 04 0d 00 12 1b 05 0f 0e 0c 16 1d 15 0e 1d 0a 17 14 17 1a 06 13 0c 14 1e
page 92: 0f 11 03 10 17 15 1d 12 0b 1a 1e 1e 03 14 04 08 18 1b 12 09 0f 09 08 06 1d 1c 05 1a 17 16 07 10
page 93: 07 19 04 05 15 0b 01 1e 04 01 0a 13 17 03 0a 00 0d 17 16 1b 17 1a 15 0e 06 14 09 03 0d 1b 03 12
page 94: 7f e5 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 95: 7f 7f d9 7f 7f 7f 7f c6 7f
page 96: ee 7f 7f 7f 7f 7f 9a 7f 7f 7f 7f 7f e1 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f 7f
page 97: 10 0a 01 16 07 11 1e 07 15 0d 10 0c 15 10 01 19 07 0a 0e 12 17 03 0b 13 0e 07 18 1d 14 10 04 0e
page 98: 15 12 0c 09 10 07 08 19 0a 16 15 0e 18 0a 00 1a 17 16 1c 0c 0d 12 1b 08 17 1d 07 00 05 14 06 1d
page 99: 00
page 100: 0d 0e 0a 0e 07 05 0e 05 0e 11 09 05 12 1a 06 13 14 1b 15 09 06 19 09 00 1a 06 09 09 07 16 0a 0d
page 101: 1c 17 18 0a 1e 1d 04 17 16 0e 10 0f 1c 0f 19 0a 1b 1b 0e 11 1c 16 0f 06 0a 15 05 1c 08 1c 09 1d
page 102: 1c 19 09 07 0f 08 0d 15 1c 12 19 02 0b 1e 04 0c 02 02 1b 1e 14 03 09 07 14 15 0d 10 03 10 1d 17
page 103: 06 06 1d 02 0f 10 0a 17 1a 07 09 0f 0e 13 18 0a 1d 0e 00 0d 10 05 1b 12 10 08 04 08 13 15 15 00
page 104: 7f 7f 7f 7f 7f 7f 8d 7f
page 105: 7f
page 106: 04 04 12 0b 02 12 1c 13 0f 18 1c 04 09 1d 1c 06 15 1b 12 15 10 07 06 01 14 04 13 0c 0d 1e 0c 0e
page 107: 00
page 108: 17 12 0c 1e 0c 0e 13 09 19 12 12 10 1e 1a 0e 0c 10 01 03 1e 03 1d 15 1c 02 09 18 00 03 0a 05
page 109: 00
page 110: 04 16 1e 14 0e 09 01 13 1d 03 19 1b 0a 1a 04 09 11 1b 10 02 1c 11 18 07 0a 02 05 0d 0c 14 19 0a
page 111: 0b 12 06 1a 0d 0f 14 09 19 0e 0d 16 14 15 1b 19 0c 13 1a 01 14 10 0c 03 08 17 1b 1e 17 1b 19 05
page 112: 08 03 1e 10 1b 12 1b 12 16 13 1d 17 1e 0c 06 06 0e 11 15 0e 1d 0c 00 10 14 07 17 06 1c 0d 1d 13
page 113: 00
page 114: 1c 0a 03 14 09 1d 19 07 0f 11 17 08 11 10 12 11 0d 0c 0c 1e 10 03 0c 17 15 02 0c 0e 1a 08 1c 19
page 115: 00
page 116: 00
page 117: 00
page 118: 1b 03 14 14 14 0c 07 1b 1c 16 10 01 08 07 07 06 14 15 05 1b 00 1d 12 14 08 15 1b 06 04 18 07 03
page 119: 19 05 04 03 09 0d 00 0d 15 19 05 00 18 0b 09 04 08 08 07 07 10 19 09 0c 0e 1a 17 1e 05 18 09 11
page 120: 7f
page 121: 18 14 05 12 03 0a 00 15 1e 13 11 07 0d 0e 0d 08 06 17 1d 19 13 00 09 1a 1e 10 11 15 07 16 0b 1a
page 122: 82 cd ad 9d ab e8 7f af 7f d3 7f f8 92 ca be aa 89 7f e9 99 bb 7f c2 e0 d7 b8 df 7f de b3 8a 7f
page 123: 14 09 1c 01 07 18 1b 0c 1c 03 12 02 07 05 00 ac 0f 08 14 01 10 10 0c 1c 03 0d 0e 0b 1e 11 10 0d
page 124: 00
page 125: 00
page 126: 00
page 127: 16 18 1b 1c 11 19 0f 07 08 08 00 13 0c 1c 01 18 06 0a 09 1d 14 0e 05 01 0b 1e 0d 14 1b 01 09 0c