Hacking FedEx Kinko's

(How not to implement stored-value smart cards)

Strom Carlson
Secure Science Corporation

LayerOne
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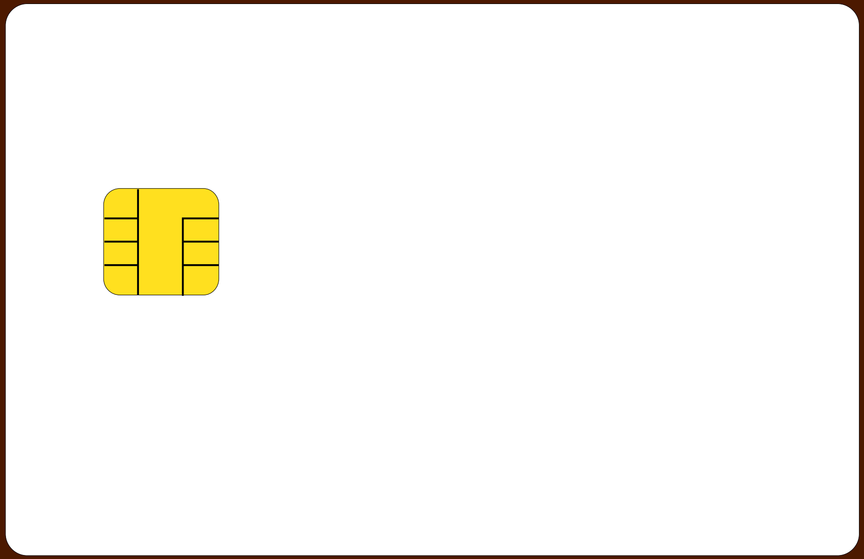
Part I

THEORY

What is a smart card?

- Plastic card, typically credit-card sized, which carries a microchip
- Can use a contact pad, a built-in antenna, or both



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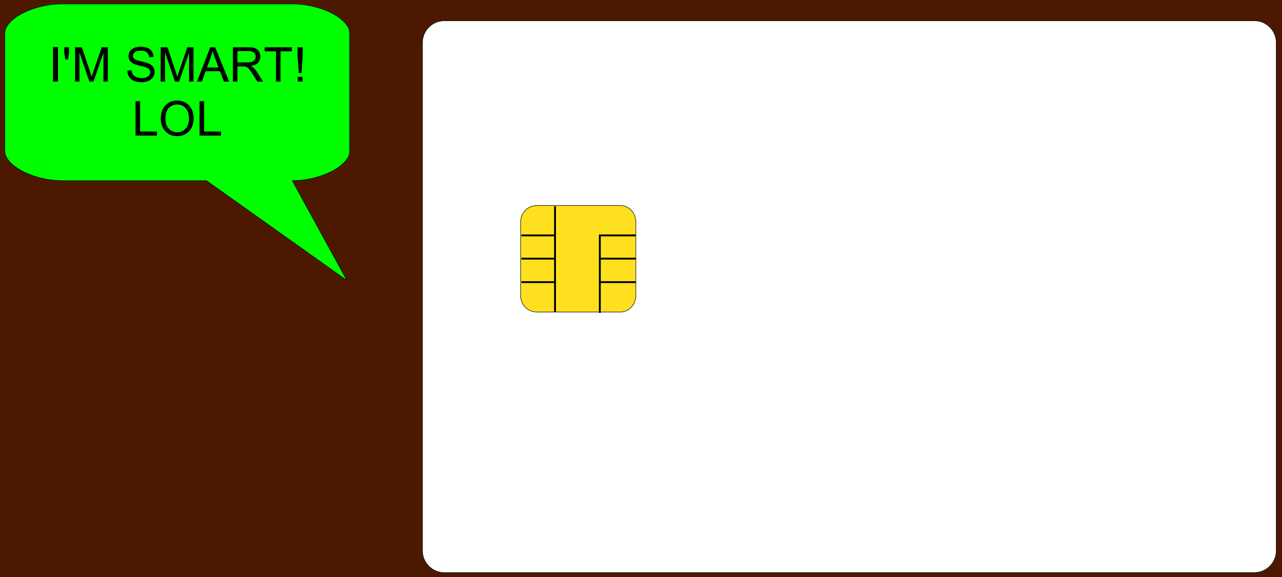

- Almost smarter than script kiddies

Two varieties of cards

- Microprocessor
  - Typically includes a small microprocessor, some RAM, and some flash ROM.
  - Often optimized for cryptographic functions
  - SIM cards in GSM phones are one example
- Memory
  - Simple EEPROM, sometimes with a microcontroller
  - Can sometimes perform basic security functions

Meet the SLE4442

- 256-byte EEPROM
- First 32 bytes are irrevocably write-protectable
- All 256 bytes are readable at any time
- Card can only be written to after presenting a three-byte security code to the microcontroller
- Card becomes unwritable after three incorrect attempts at writing the security code
  - You can brute-force the code if you have 5.6 million identical cards and a lot of free time

Meet the SLE4442

Why use the SLE4442?

- One of the cheapest cards on the market
  - $0.36 each in quantities of 200,000
    - http://www.smartcardworld.com/SLE4442.asp
- Security function prevents casual attacker from altering data
- More durable and secure than a magstripe card

Who uses the SLE4442?

FedEx Kinko's

(Some random tiny xerox shop you've obviously never heard of)

ExpressPay

- Stored-value card system utilizing the SLE4442
- Customers add cash value to cards at a kiosk
- Cards are debited as users make copies, use computers, and so on.
- Cards can be refilled
- Developed by enTrac Technologies of Toronto
- Implemented at Kinko's in 2001

ExpressPay Questions

- Is any personally identifiable information stored on the card?
- Is a transaction history stored on the card?
  - Customers can print receipts at the kiosk after using self-service systems
- How secure is the data?
  - Card offers no built-in cryptographic function
  - Data could theoretically be encrypted before being stored on the card itself

ExpressPay Questions

- Is value even stored on the card?
  - Cards could just be serialized tokens with all value stored on the back-end
- What else is stored on the card?

Reading the SLE4442

- Card conforms only to the following ISO standards:
  - 7816-1: Physical Characteristics
  - 7816-2: Dimensions and Locations of Contacts
  - 7816-3: Electrical characteristics and class indication for integrated circuit(s) cards operating at 5V, 3V and 1.8V

Reading the SLE4442

- Card does not conform to ISO 7816-4
  - Organization, security and commands for interchange
    - Contents of command-response pairs exchanged at the interface
    - Means of retrieval of data elements and data objects in the card
    - Structures and contents of historical bytes to describe operating characteristics of the card
    - Structures for applications and data in the card, as seen at the interface when processing commands
    - (continued…)

Reading the SLE4442

- ISO 7816-4 Continued:
  - Access methods to files and data in the card
  - A security architecture defining access rights to files and data in the card
  - Means and mechanisms for identifying and addressing applications in the card
  - Methods for secure messaging
  - Access methods to the algorithms processed by the card

Reading the SLE4442

- This card cannot be read in a reader which expects only ISO 7816-4 compliant cards.
  - American Express “Blue” Card readers…no such luck.
- Some readers are able to read this card plus a variety of other memory cards

Reading the SLE4442

- Advanced Card Systems ACR-30U
  - USB reader
  - Windows and Linux drivers available
  - Reads the SLE4442
  - Costs about $30.00 USD

What's on the card?

```
0x00 | A2 13 10 91 46 FF 81 15              0x80 | 72 00 00 00 00 00 00 00
0x08 | FF FF FF FF FF FF FF FF              0x88 | 00 00 00 00 00 00 00 39
0x10 | FF FF FF FF FF D2 76 00              0x90 | 39 31 31 00 31 30 31 00
0x18 | 00 04 09 FF FF FF FF FF (1)          0x98 | 30 30 30 30 30 00 00 00
0x20 | 00 00 00 00 00 00 F0 3F (2)          0xA0 | 00 00 00 00 00 00 00 00
0x28 | 00 00 00 00 00 00 00 00              0xA8 | 00 00 00 00 00 00 00 00
0x30 | 20 05 09 21 16 05 45 69 (3) (4)      0xB0 | 00 00 00 03 00 00 01 00
0x38 | 00 00 00 00 00 00 00 00              0xB8 | 00 00 00 00 00 00 00 00
0x40 | 00 00 FF FF FF FF FF FF              0xC0 | 00 00 00 00 00 00 00 20 (6)
0x48 | FF FF FF FF FF FF FF FF              0xC8 | 05 09 21 16 05 45 69 00 (7)
0x50 | FF FF FF FF FF FF FF FF              0xD0 | 00 00 00 FF FF FF FF FF
0x58 | FF FF FF FF FF FF FF FF              0xD8 | FF FF FF FF FF FF FF FF
0x60 | 31 31 36 33 30 30 33 32              0xE0 | FF FF FF FF FF FF FF FF
0x68 | 33 30 39 00 00 00 00 00 (5)          0xE8 | FF FF FF FF FF FF FF FF
0x70 | 00 00 00 00 43 61 73 68              0xF0 | FF FF FF FF FF FF FF FF
0x78 | 20 43 75 73 74 6F 6D 65              0xF8 | FF FF FF FF FF 00 00 00
```

http://www.stromcarlson.com/ | http://www.securescience.net/

What's on the card?

```
0x00  A2 13 10 91 46 FF 81 15              0x80  72 00 00 00 00 00 00 00
0x08  FF FF FF FF FF FF FF FF              0x88  00 00 00 00 00 00 00 39
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0x18  00 04 09 FF FF FF FF FF (1)          0x98  30 30 30 30 30 00 00 00
0x20  00 00 00 00 00 00 F0 3F (2)          0xA0  00 00 00 00 00 00 00 00
0x28  00 00 00 00 00 00 00 00              0xA8  00 00 00 00 00 00 00 00
0x30  20 05 09 21 16 05 45 69 (3) (4)      0xB0  00 00 00 03 00 00 01 00
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0x40  00 00 FF FF FF FF FF FF              0xC0  00 00 00 00 00 00 00 20 (6)
0x48  FF FF FF FF FF FF FF FF              0xC8  05 09 21 16 05 45 69 00 (7)
0x50  FF FF FF FF FF FF FF FF              0xD0  00 00 00 FF FF FF FF FF
0x58  FF FF FF FF FF FF FF FF              0xD8  FF FF FF FF FF FF FF FF
0x60  31 31 36 33 30 30 33 32              0xE0  FF FF FF FF FF FF FF FF
0x68  33 30 39 00 00 00 00 00 (5)          0xE8  FF FF FF FF FF FF FF FF
0x70  00 00 00 00 43 61 73 68              0xF0  FF FF FF FF FF FF FF FF
0x78  20 43 75 73 74 6F 6D 65              0xF8  FF FF FF FF FF 00 00 00
```

32-byte header which remains the same across all cards

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```
0x00 | A2 13 10 91 46 FF 81 15            0x80 | 72 00 00 00 00 00 00 00
0x08 | FF FF FF FF FF FF FF FF            0x88 | 00 00 00 00 00 00 00 39
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0x28 | 00 00 00 00 00 00 00 00            0xA8 | 00 00 00 00 00 00 00 00
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0x48 | FF FF FF FF FF FF FF FF            0xC8 | 05 09 21 16 05 45 69 00 (7)
0x50 | FF FF FF FF FF FF FF FF            0xD0 | 00 00 00 FF FF FF FF FF
0x58 | FF FF FF FF FF FF FF FF            0xD8 | FF FF FF FF FF FF FF FF
0x60 | 31 31 36 33 30 30 33 32            0xE0 | FF FF FF FF FF FF FF FF
0x68 | 33 30 39 00 00 00 00 00 (5)        0xE8 | FF FF FF FF FF FF FF FF
0x70 | 00 00 00 00 43 61 73 68            0xF0 | FF FF FF FF FF FF FF FF
0x78 | 20 43 75 73 74 6F 6D 65            0xF8 | FF FF FF FF FF 00 00 00
```

Dollar value stored on the card

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What's on the card?

```
0x00 | A2 13 10 91 46 FF 81 15              0x80 | 72 00 00 00 00 00 00 00
0x08 | FF FF FF FF FF FF FF FF              0x88 | 00 00 00 00 00 00 00 39
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0x60 | 31 31 36 33 30 30 33 32              0xE0 | FF FF FF FF FF FF FF FF
0x68 | 33 30 39 00 00 00 00 00 (5)          0xE8 | FF FF FF FF FF FF FF FF
0x70 | 00 00 00 00 43 61 73 68              0xF0 | FF FF FF FF FF FF FF FF
0x78 | 20 43 75 73 74 6F 6D 65              0xF8 | FF FF FF FF FF 00 00 00
```

Date and time the card was first issued

YY-MM-DD
05-09-21

HH:MM:SS.SS
16:05:45.69

http://www.stromcarlson.com/ | http://www.securescience.net/

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0x00 | A2 13 10 91 46 FF 81 15              0x80 | 72 00 00 00 00 00 00 00
0x08 | FF FF FF FF FF FF FF FF              0x88 | 00 00 00 00 00 00 00 39
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0x78 | 20 43 75 73 74 6F 6D 65              0xF8 | FF FF FF FF FF 00 00 00
```

Serial number

11630032309

http://www.stromcarlson.com/ | http://www.securescience.net/

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0x70 | 00 00 00 00 43 61 73 68                 0xF0 | FF FF FF FF FF FF FF FF
0x78 | 20 43 75 73 74 6F 6D 65                 0xF8 | FF FF FF FF FF 00 00 00
```

Store number where card was issued

1163

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0x78  20 43 75 73 74 6F 6D 65              0xF8  FF FF FF FF FF 00 00 00
```

Individual card number

0032309

http://www.stromcarlson.com/ | http://www.securescience.net/

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0x78 | 20 43 75 73 74 6F 6D 65              0xF8 | FF FF FF FF FF 00 00 00
```

Another timestamp

Stored Dollar Value

- Initially confusing, as all other values stored on the card are fairly easy-to-understand plaintext
- Some values:

7B 14 AE 47 E1 7A A4 BF	- $0.04
00 00 00 00 00 00 00 00	$0.00
7B 14 AE 47 E1 7A 84 3F	$0.01
7B 14 AE 47 E1 7A A4 3F	$0.04
9A 99 99 99 99 99 A9 3F	$0.05
9A 99 99 99 99 99 C9 3F	$0.20
00 00 00 00 00 00 F0 3F	$1.00
66 66 66 66 66 66 1E 40	$7.60
00 00 00 00 00 00 34 40	$20.00

Stored Dollar Value

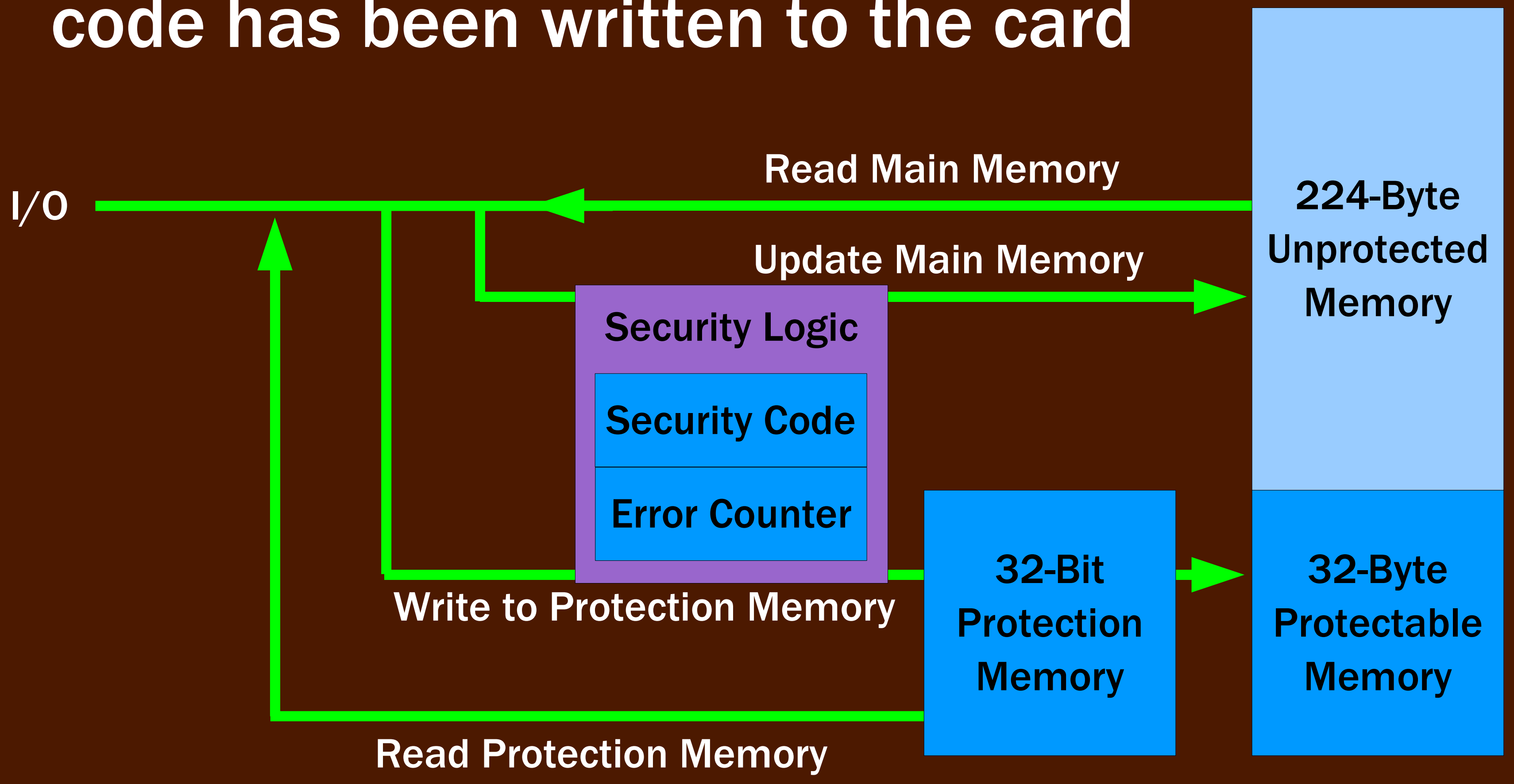
- Turns out the encoding is IEEE 754 double precision floating point format (little-endian)
- Maximum value:
  - $99,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999,999,
    999,999,999,999,999,999,999,999,999,999,999,999
  - That's (1E308 - 1) for all you slow counters ;)

Security Code

- Card is protected only by a three byte (24 bit) security code
- 16.7 million possible combinations
- All Kinko's cards likely have the same code
  - Blank cards from the kiosk do not have the default manufacturer's code
  - Deriving the code from changeable data may cause card to become inoperable if changeable data becomes corrupted somehow
  - Everything else about this card is ass-easy anyway

Attack?

- Security code can only be read once the correct code has been written to the card



Possible Attacks

- Social Engineering
- Emulate the SLE4442
- Intercept the code during transmission
- Read memory directly

Social Engineering Attack

- Contact enTrac technologies and extract the code from some unsuspecting employee
- PROS:
  - Requires the least technical jiggery-pokery of the available methods; just dial the phone
- CONS:
  - Code might be so secret that no one but enTrac engineers know about it
  - Tough to repeat if the code is changed
  - No technical challenge

Emulate the SLE4442

- Use a smartcard emulator plugged into a laptop
- PROS:
  - Fairly foolproof; this method is used by developers
- CONS:
  - Emulator dongles are bulky and don't work well with the motorized transport found in some card readers; the dongle won't go all the way into the slot
  - SLE4442 emulation software might be difficult to obtain or might not exist at all

Emulate the SLE4442

- Find a microprocessor-based smart card that can behave just like the SLE4442
- PROS:
  - Easy to clandestinely retrieve the code by sticking the card into any device which attempts to write to it
  - Elegant attack that renders any SLE4442 system vulnerable
- CONS:
  - Every microprocessor card I've looked at seems to follow ISO 7816, not SLE4442 specs.

Intercept the security code

- Wire the card's contact points to a logic analyzer, capture a transaction, and analyze the data later
- PROS:
  - Small USB logic analyzers are readily available for under $300
  - Wiring can be easily hidden; little chance of card rejection since you're using a real SLE4442
- CONS:
  - Easy to screw up if you don't have solder-fu

Read memory directly

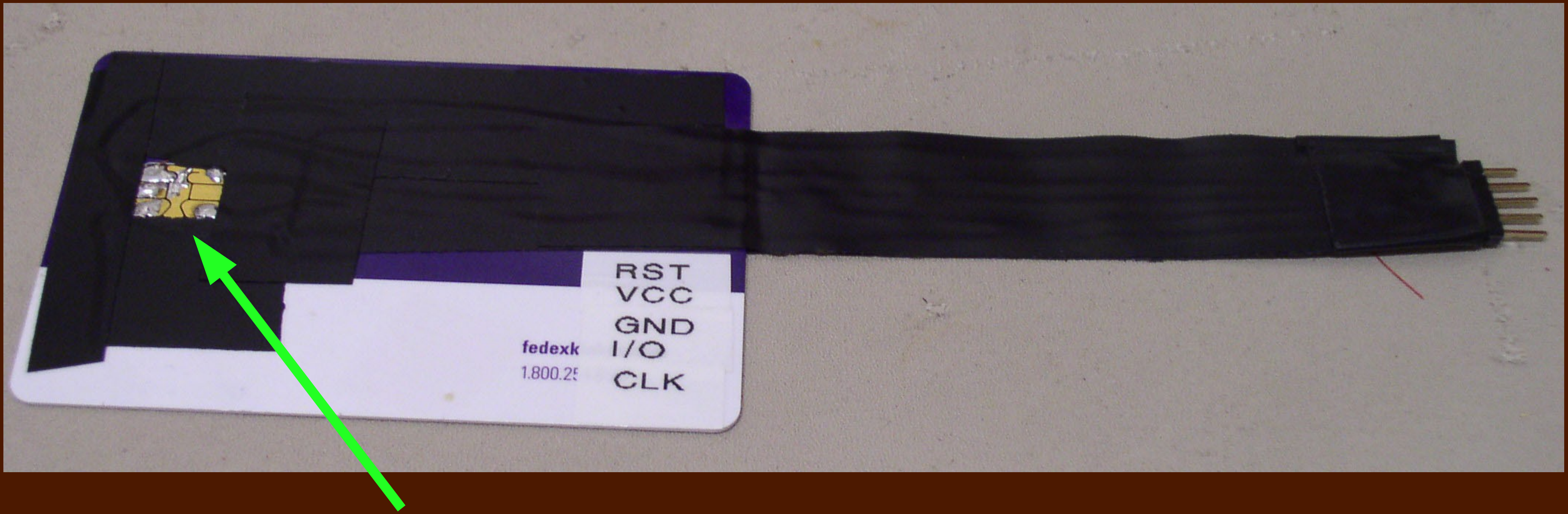
- Burn the epoxy off the chip and read the security memory directly
- PROS:
  - None of that tedious mucking around with transactional data
- CONS:
  - EXPENSIVE unless you know someone with the ability and equipment to read directly off the silicon die.

Part II

ATTACK!

Logic Analyzer Attack

- Solder wires to a stored-value card
- Attach logic analyzer
- Go to Kinko's



Check out my totally awesome uber-leet soldering skillz

And we get...

```
0100010111001000000010001000100100000110010101000111111111010010110110111000000000000000000010000
0100100001111111111111111111111111111111111111111000111010111100010100001110101111000101000011101
0111100111111100000000000000000000000000000000000000000000000000000000000000000000000100101000001
1000000000101000100010001101100101000000110011000000000000000000000000000000000000000000000000000
0000000000000000000000000000001111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111110011001110110000001
1000100110000001100000011000110110000001100000011000001110010001100000000000000000000000000000000
0000000000000000000000000000000000000000001100001010000110110011100001011000000100110000101010111
0110011100010111011110110101101101010011001001110000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000000100111001001110010001100100011000
0000000100011000000110010001100000000000000001100000011000000110000001100000011000000000000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000000000000000000000000000000110000000000000000000000010000000000
0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000010010100000110000000001010001000100011011001010100010000010000000
0000000000000000000000000011111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111100000000000000000000000000
0001100101000101111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111111
1111111111111111111111111111111111111111111111110011001110110000001100010011000000110000001100011
0110000001100000011000001110010001100000000000000000000000000000000000000000000000000000000000000
0000000000001100001010000110110011100001011000000100110000101010111011001110001011101111011010110
1101010011001001110000000000000000000000000000000000000000000000000000000000000000000000000000000
0000000000000000000000000000000000100111001001110010001100100011000000000010001100000011001000110
000000000000011000000110000001100000000110000001100000000000000000000000000000000000000      [ETC]
```

Commands

- 00001100 – Read Main Memory
- 00011100 – Update Main Memory
- 00101100 – Read Protection Memory
- 00111100 – Write Protection Memory
- 10001100 – Read Security Memory
- 10011100 – Write Security Memory
- 11001100 – Compare Verification Data

SLE4442 Command Structure

- Command Byte
- Address Byte
- Data Byte

Security Code Presentation

- Read Security Memory
- Update Security Memory
- 3x Compare Verification Data
  - Numbered byte indicating which byte of security code follows (01, 02, or 03)
  - One byte of security code
- Update Security Memory
- Read Security Memory

Stepping through the data

```
ANSWER TO RESET:
01000101  A2
11001000  13
00001000  10
10001001  91

0         PROCESSING CYCLE

00001100  READ MAIN MEMORY
10101000  15
11111111  FF

1         PROCESSING CYCLE

01001011  D2  [BEGIN HEADER]
01101110  76      |
00000000  00      |
00000000  00      |
00100000  04      |
10010000  09      |
11111111  FF      |
11111111  FF      |
11111111  FF      |
11111111  FF      V
11111111  FF  [END HEADER]
00011101  B8  [BEGIN VALUE]
01111000  1E      |
10100001  85      |
11010111  EB      |
10001010  51      |
00011101  B8      |
01111001  9E      V
11111100  3F  [END VALUE]
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
```

```
00000100  20  [BEGIN TIMESTAMP]
10100000  05      |
11000000  03      |
00010100  28      |
01000100  22      |
01101100  36      |
10100000  05      V
01100110  66  [END TIMESTAMP]
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
```

```
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11111111  FF
11001100  33  [BEGIN SERIAL NUMBER]
11101100  37      |
00001100  30      |
01001100  32      |
00001100  30      |
00001100  30      |
01101100  36      |
00001100  30      |
00001100  30      |
00011100  38      V
10001100  31  [END SERIAL NUMBER]
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
00000000  00
11000010  43
10000110  61
11001110  73
00010110  68
00000100  20
11000010  43
10101110  75
11001110  73
00101110  74
11110110  6F

[CONTINUED...]
```

Stepping through the data

(thousands of very boring bytes later)

Stepping through the data

```
11111111
11111111
11111111
11111111
11111111
00000000
00000000
00000000  [END OF MAIN MEMORY]

0

10001100  READ SECURITY MEMORY
11111111  FF
11111111  FF
11110000
00000000
00000000
00000000
00
10011100  UPDATE SECURITY MEMORY
00000000
01100000
10000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
```

```
00000000
00000000
00000000
00000000
00000
11001100  COMPARE VERIFICATION DATA
10000000  01
XXXXXXXX  XX
1000
11001100  COMPARE VERIFICATION DATA
01000000  02
XXXXXXXX  XX
1000
11001100  COMPARE VERIFICATION DATA
11000000  03
XXXXXXXX  XX
1000
10011100  UPDATE SECURITY MEMORY
00000000
11100000
10000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
00000000
```

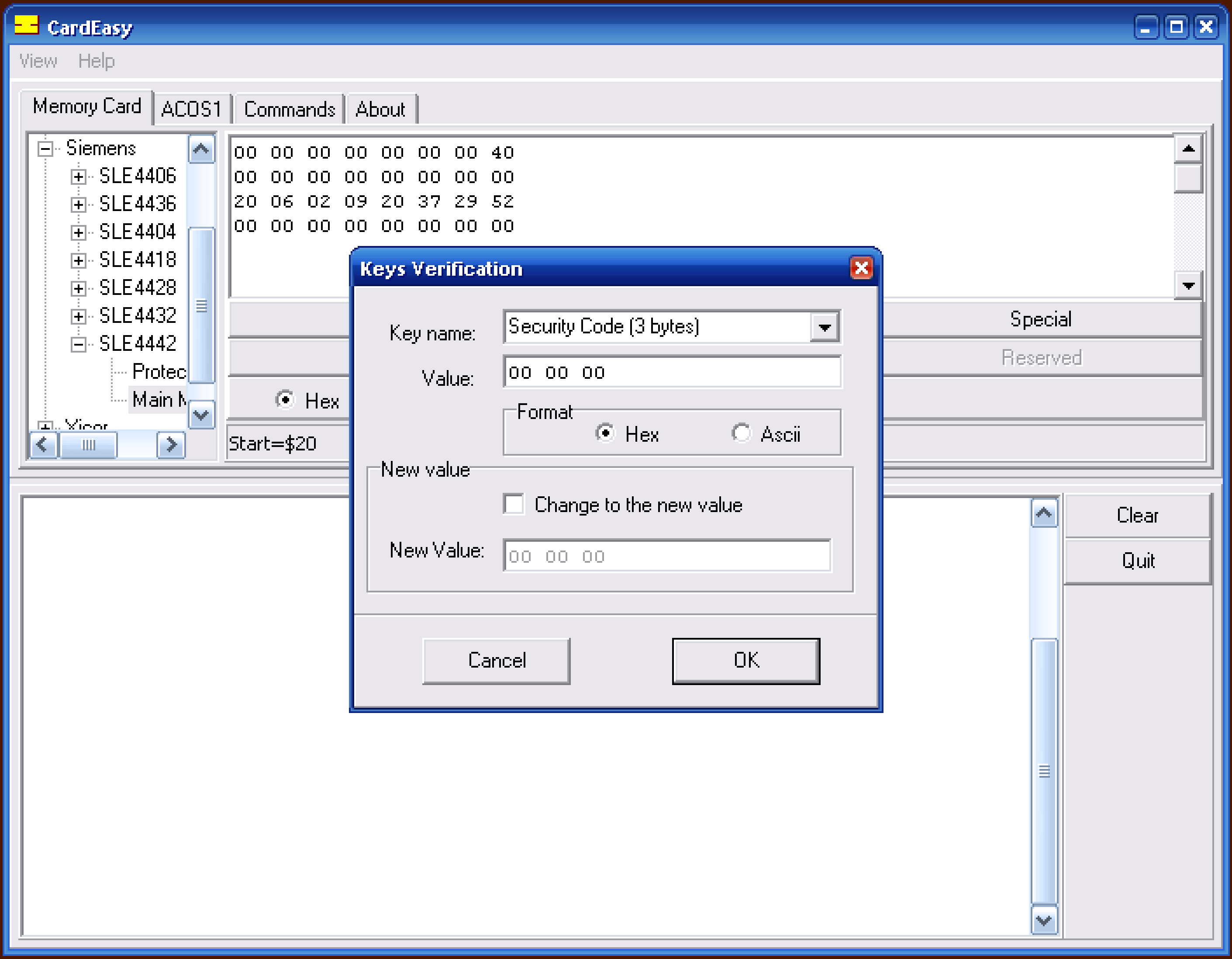
```
00000000
00000000
00000
10001100  READ SECURITY MEMORY
11111111
11111111
11110000


....


WHY AM I STILL ANALYZING THIS?
```

```
         )
        (.)    I'M THE INFORMATION SECURITY
        .|.    RESPONSIBILITY CUPCAKE
        l7J    AND IT'S MY JOB TO TELL YOU
        | |       THAT YOU ARE GOING TO HAVE TO
    _.--| |--._     FIGURE OUT THE SECURITY CODE
 .-';  ;`-'& ; `&.     FOR YOURSELF!
& &  ;  &   ; ;   \
\      ;    &   &_/
 F"""---...---"""J
 | | | | | | | | |
 J | | | | | | | F     ALSO: DEAD HOOKERS
  `---.|.|.|.---'
```

Manipulating the card



```
00 00 00 00 00 00 00 40
00 00 00 00 00 00 00 00
20 06 02 09 20 37 29 52
00 00 00 00 00 00 00 00
```

● Hex

Start=$20

Keys Verification

Key name: Security Code (3 bytes)

Value: 00 00 00

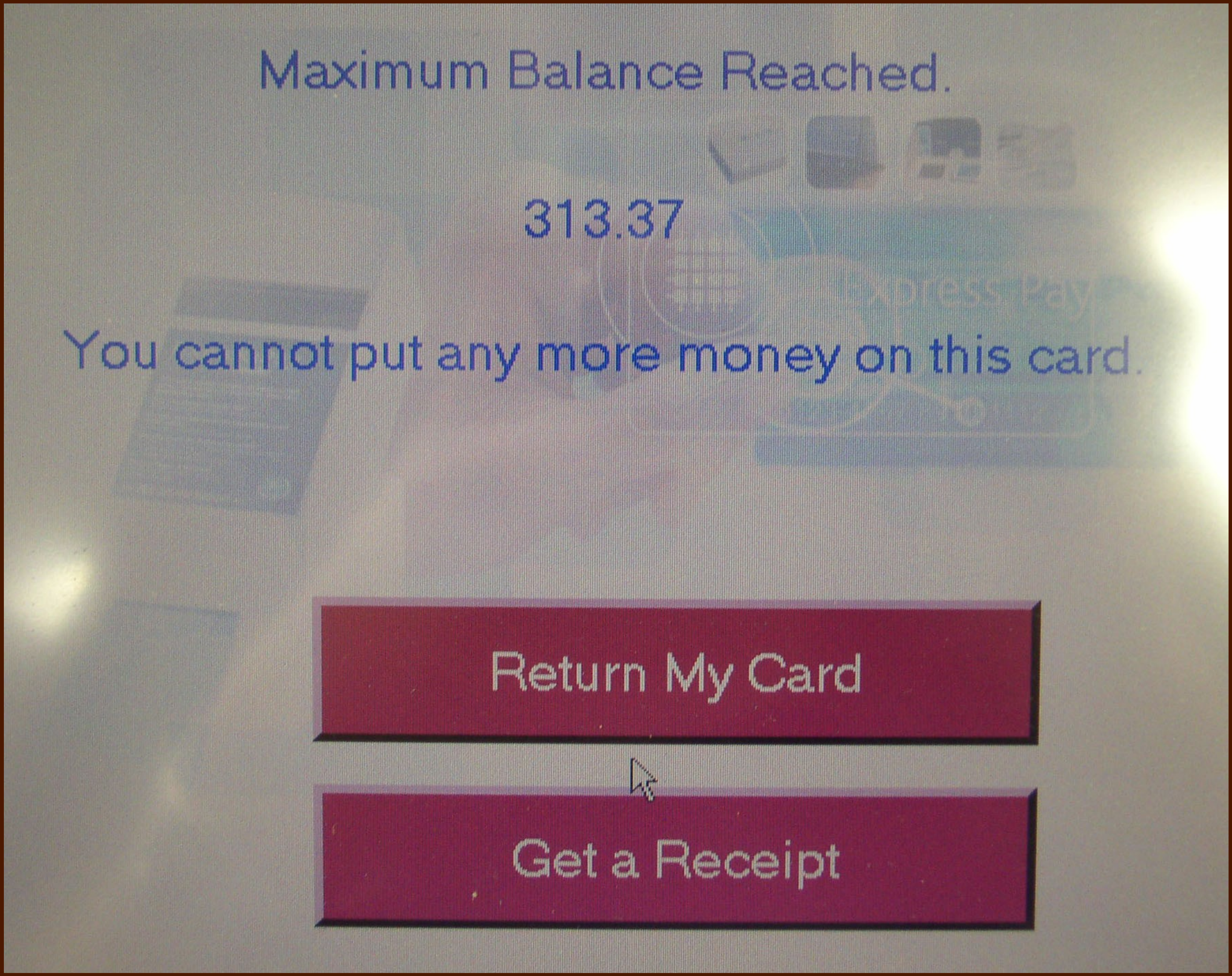
Format: ● Hex ○ Ascii

New value

□ Change to the new value

New Value: 00 00 00

LOL Intarwebs



Maximum Balance Reached.

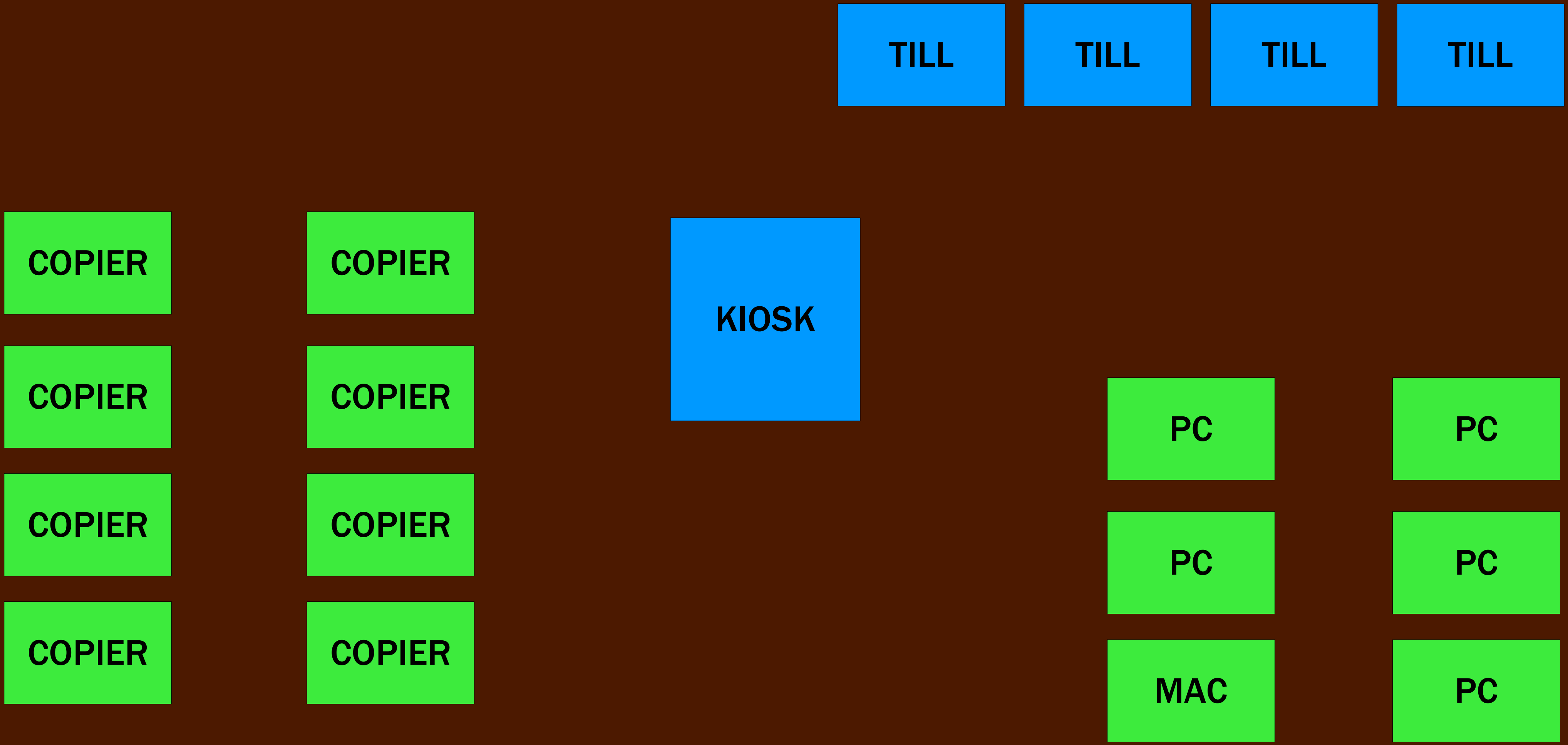
313.37

You cannot put any more money on this card.

Part III

PLAYING WITH THE BACK END

A typical FedEx Kinko's



TILL

TILL

TILL

TILL

COPIER

COPIER

COPIER

COPIER

COPIER

COPIER

COPIER

COPIER

KIOSK

PC

PC

PC

PC

MAC

PC

Card cloning

- Does the system reconcile the balance on the back end with the balance on the card?
  - Step 1: Buy $1 card
  - Step 2: Clone card
  - Step 3: Make a few xeroxes with original card
  - Step 4: Print receipt from kiosk with cloned card

Value Alteration

- Does the system do anything if the card balance mysteriously increases?
  - Step 1: Buy $1 card
  - Step 2: Rewrite card value to $2
  - Step 3: Make several xeroxes (less than $1 worth)
  - Step 4: Print receipt at kiosk

Weird Serial Numbers

- Does the system freak out if the card's serial number is from a nonexistent store?
- Does the system verify that the serial number is valid?
  - Step 1: Buy $1 card
  - Step 2: Alter serial number to something unlikely (99687654321 for example – there is no store 9968)
  - Step 3: Make xerox with altered card
  - Step 4: Print receipt

Cloned Cards Part II

- Is a card's serial number invalidated if you redeem the card for its stored value?
  - Step 1: Buy $1 card and destroy it
  - Step 2: Buy $1 card
  - Step 3: Make xerox with card
  - Step 4: Clone the card
  - Step 5: Redeem original card
  - Step 6: Make xerox with cloned card
  - Step 7: Print receipt at kiosk with cloned card

Cloned Cards Part II

- OK, maybe it takes some time for the card to be invalidated.
  - Step 8: Go eat pizza or something
  - Step 9: Come back and try the cloned card again

Cloned Cards Part II

- Maybe, just maybe, the system might take a whole day to invalidate the card.
  - Step 10: Go back a day or six later

Fun Facts

- enTrac Technologies has exactly one product: ExpressPay
- The company slogan is “Counter Intelligence”

Part IV

ENGINEERING A BETTER SYSTEM

Keep the SLE4442

- Change the way values are stored
- Change the way the security code works
- Change the method for verifying the cards
- PROS
  - Does not require hardware changes
  - Relatively inexpensive
- CONS
  - Still somewhat insecure

Increasing Security with the SLE4442

- Verify information on the cards
  - Generate a hash based on the serial number, value, and timestamp, and verify that against a hash stored on the server
  - Store a second hash on the card based on the same data to verify the card has not been altered
- Don't store values in plaintext on the cards
  - Make it more difficult to reverse-engineer the contents of the card

Increasing Security with the SLE4442

- Do not store value on the cards themselves
  - Use the cards only as serialized tokens and pull the value from the network
  - Store a hash on the card to verify that the value on the network hasn't been altered
- Invalidate the cards when they're cashed out
  - (duh)

Increasing Security with the SLE4442

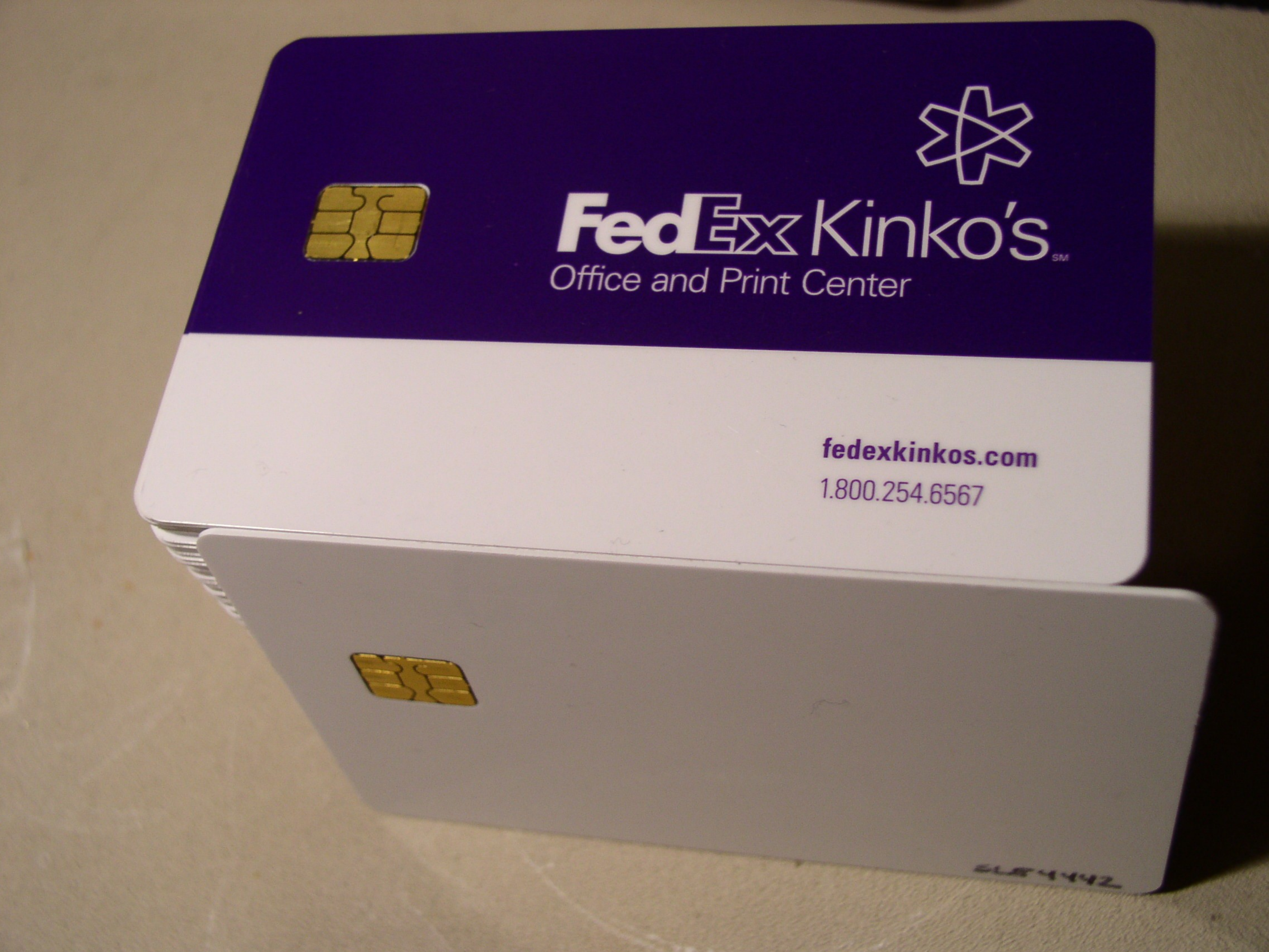
- Don't use the same security code for every single card in circulation
  - Use a code derived from some randomized rotating value stored on the network
  - Do not base the code on any value stored on the card

Use a different chip

- Use a cryptographic secure memory chip
  - Atmel CryptoMemory chips used by my laundromat
- Use a chip with a microprocessor
  - Challenge-response authorization
  - Encryption of data
  - Access control
  - Hidden Goatse

Charge a deposit for the smartcard

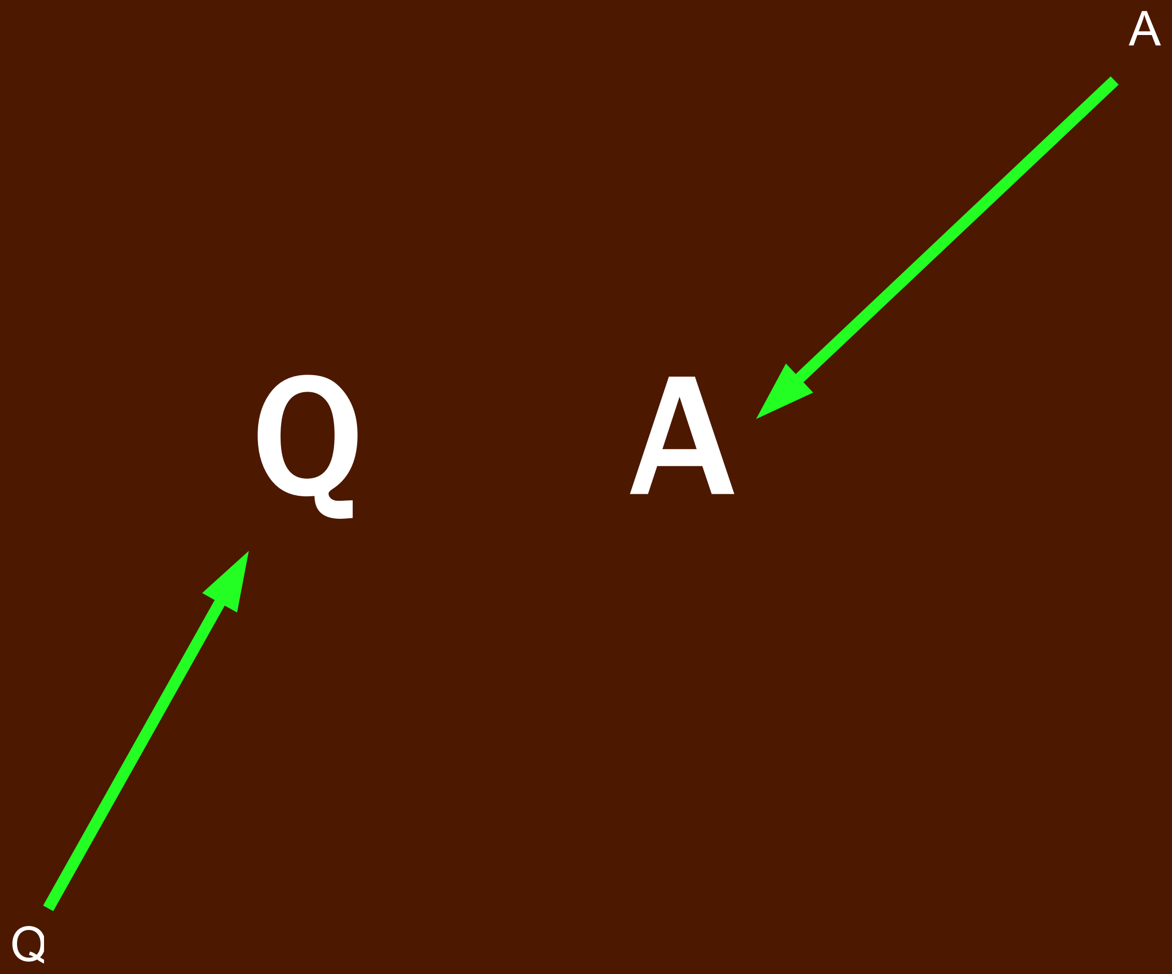
- Currently, cards are free for the taking
  - “More secure cards are too expensive”
- Charge $1 or $2 to obtain the card
- Refund the deposit when the card is returned to an employee
  - This will help prevent curious tinkerers from obtaining massive numbers of cards for play and analysis


FedEx Kinko's SM
Office and Print Center
fedexkinkos.com
1.800.254.6567
SLE4442

Resources

- http://www.securescience.net/
- http://www.stromcarlson.com/
- http://www.infineon.com/
- http://www.atmel.com/
- http://www.smartcardsupply.com/

Q&A



A

Q A

Q