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Threat Modeling against Payment systems

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Agenda

- Threat Modeling Highlights
- Point of Sale (#POS)
- Point of Interaction (#POI)
- Locked and Unlocked POI devices
- Tricks with POI
- Tricks with Virtual Terminals
- The outcome of a Threat Modeling exercise

Threat Modeling

- A process by which potential threats can be identified, enumerated, and prioritized – all from a hypothetical attacker's point of view.
  - The purpose of threat modeling is to provide defenders with a systematic analysis of the probable attacker's profile; meaning, the most likely attack vectors, and the assets most desired by an attacker.
  - Threat modeling answers the questions "Where are the high-value assets?" "Where am I most vulnerable to attack?" "What are the most relevant threats?" "Is there an attack vector that might go unnoticed?"

Multiple approaches to threat modeling

- **OWASP** : www.owasp.org/index.php/Threat_Risk_Modeling
- **SAFECode** : www.safecode.org (non-profit)
  - Software Assurance Forum for Excellence in Code

- Software centric threat modeling
- Security centric threat modeling
- Asset or risk centric threat modeling

Approaching Threat Modeling

- STRIDE stands for:
  - **S**poofing
  - **T**ampering
  - **R**epudiation
  - **I**nformation disclosure
  - **D**enial of service
  - **E**levation of privilege

Approaching Threat Modeling

- DREAD stands for:
  - **D**amage
  - **R**eproducibility
  - **E**xploitability
  - **A**ffected users
  - **D**iscoverability

Keep in mind..

Performing threat modeling provides a far greater return than spending £££s for fraud control for a system that has negligible fraud risk. Make threat risk modeling an early priority in your application design process.

#**threat**modeling

POI Devices

- You have likely used a Point of Interaction (Chip & PIN device)
  - Remember your PIN; you need it for transactions
  - Keep your PIN safe; so no one can use your card

Assumptions

- ..from your side:
  - I will **not** mention POI manufacturers
  - I will **not** tell you which OS vendor(s)

Assumptions

- ..from my side:
  - You will behave after the presentation!
  - If you decide to fly to #LasVegas (after having seen all these tricks), you promise to take me with you (and pay for my plane ticket).
  - Seriously! ;)

Keep in mind..

It is getting easier by the day for fraudsters and cyber criminals to get their hands on “live” payment systems.

#**attack**waiting**to**happen

Locked and Unlocked POI devices

- There are 2 types of POI devices (terminals); the ones which are Locked and the ones that are Unlocked.
  - The Unlocked ones, have no open ports.
  - The Locked ones, have 1 open port
- The locked POI is controlled by an Electronic Cash Register (ECR or ePOS), which is responsible for unlocking the device, opening a new receipt and accepting a transaction.
  - Locked POI devices can be found unattended!
  - Locked POI devices, can be unlocked in 7 to 10 sec.

Getting to know the rules

- Until recently it was so much easier..
  - Successful transactions were sent every 24 hours.
  - Clearing the transactions cache used to be a few clicks away.
- Since last year onwards..
  - Successful transactions are sent back in “real-time“
  - Clearing the transactions cache is now protected by a “secure code” (like a PIN, that only few people know)

Ways to never actually pay for a transaction..

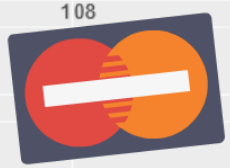
- Bypass restrictions
  - Get access in the internal network, send commands to the POI: Close Receipt, Open New Receipt with new Amount, Complete Payment
  - Pay as normal but instead of trying to clear the cache, remove the OS completely, with a quick key combination.

How to..

- Delete the OS
  - After Reset, when a specific string appears on the screen
  - [Key 1] > [Key 2] > [Key 3] > [Key 4]
  - Terminal resets and displays boot screen
  - Everything is deleted
  - Keeps BIOS, Hardware configuration file, Ethernet configuration file

Do you speak POS?

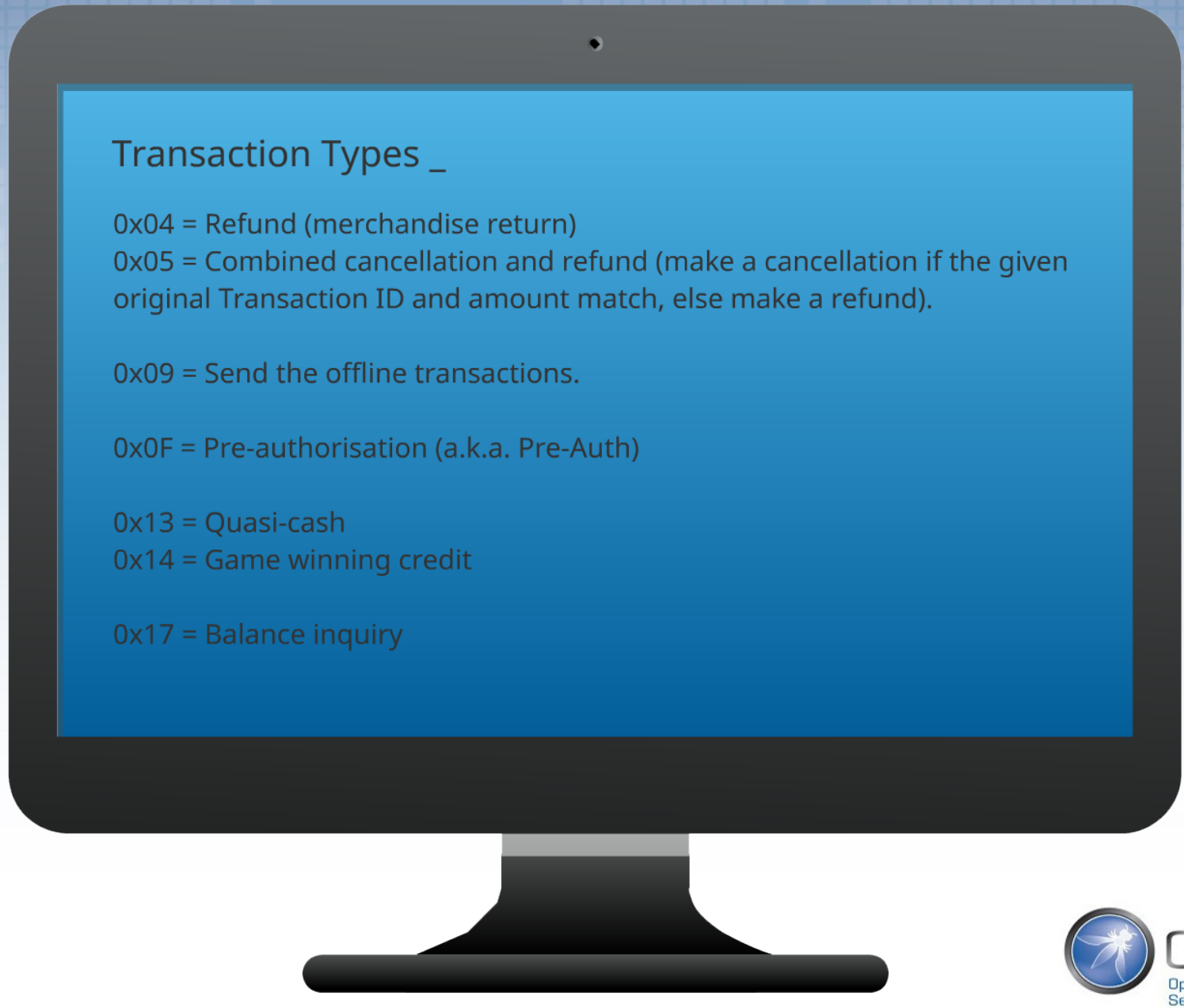
Name	Type	Lenght	Example value HEX	Info
Control	Byte	1	F1	Constant Control byte
Control	Byte	1	F1	Constant Control byte
Control	Byte	1	F1	Constant Control byte
PacketType	Byte	1	08	
Frame Content Length	Integer			
Application Type	Integer			
Connection	Integer			
Command	Integer	4	00000001	Depends on the request to be sent.
DataLength	Integer	4	00000105	Length of the data container
...Data...	string	var	...	Message data.



Commands to send

253 - POS Open
254 - POS Close
251 - Receipt Open
252 - Receipt Close

250 - Cancel Transaction
370001 - Change Amount



How to pay with someone else's card..

- Because you don't know the PIN:
  - While in payment state, press [Key] > [Key]
  - It prints a receipt which you need to sign instead (PIN is not used)
  - The message on the screen says that the transaction is accepted and prompts the user with "Remember Signature". #SignatureMode
  - If you hit Green, the message will go away and the customer copy will start printing

How to pay with someone else's card..

- Because you don't know the PIN and you don't want to sign the retailer's copy either:
  - Enter the Card upside down.
  - POI thinks the Chip is not working and asks you to swipe the card instead.
  - Should raise a fallback alert to the card issuer.
  - Swipe the card and transaction is complete.

How to pay with someone else's card..

- By "blocking" the wireless communication:
- Wait for 2 tries and press [Key] for manual
- Tells you to contact the bank to give you the "proceed" code.
  - If == AMEX, enter any 2 digits.
  - If != AMEX enter a number that validates the Luhn algorithm.
- Maybe clear the OS after the payment is accepted? ;)

How to get paid instead of paying..

- Find an unattended locked POS:
- Unlock the POS using a key combination.
- Enter your card and request a #refund to be send to your account.
  - Enter your card but this time request a refund to be send to your account, “marked” as winnings from gambling!?!

How to get a significant discount..

- During a normal payment, when the POI is **unlocked**:
  - Pull your card out (just 2 mm).
  - Wait 6 seconds!
  - Press: MENU > [key] > Enter the amount you want to pay > OK > [Push Card In] > [key]
  - Give the POS back to the merchant
  - Smile! :D

The Cuckoo example..

- Assuming you are an existing merchant:
  - Instead of tampering with the POI and risk getting caught, **replace** the target POI with one of your own.
    (#ConArtist skills highly recommended) #WhiteCollar
  - **No one** checks the serial numbers at the back of the POS before every single transaction. ;)

POS & Contactless

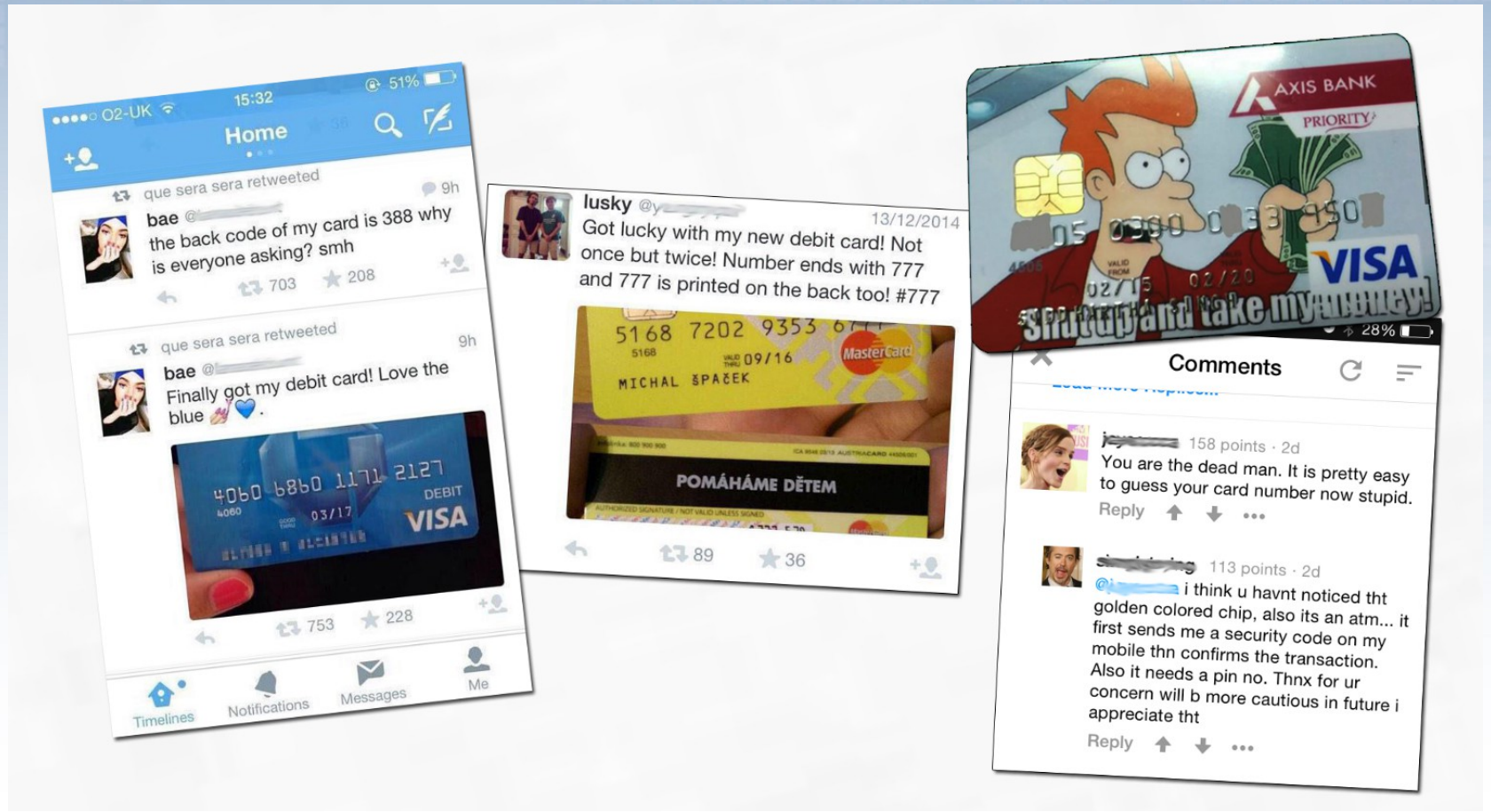
- All of the above apply, plus..
  - No need for PIN
  - If you are prompted for a PIN use any of the previous methods
  - You can charge a card more than once using different contactless POS devices only milliseconds after each transaction!
  - Do not have two POS devices trying to read the same card at the same time.
  - #Contactless have a £30 limit per transaction (not in all countries). There are considerations to remove the limit in the near future.
  - More work to be done…

Now that you know all that, we need Card Info

How may people take pictures and
put their card information online?

#creditcard, #debitcard, #cvv

If you want to go shopping..



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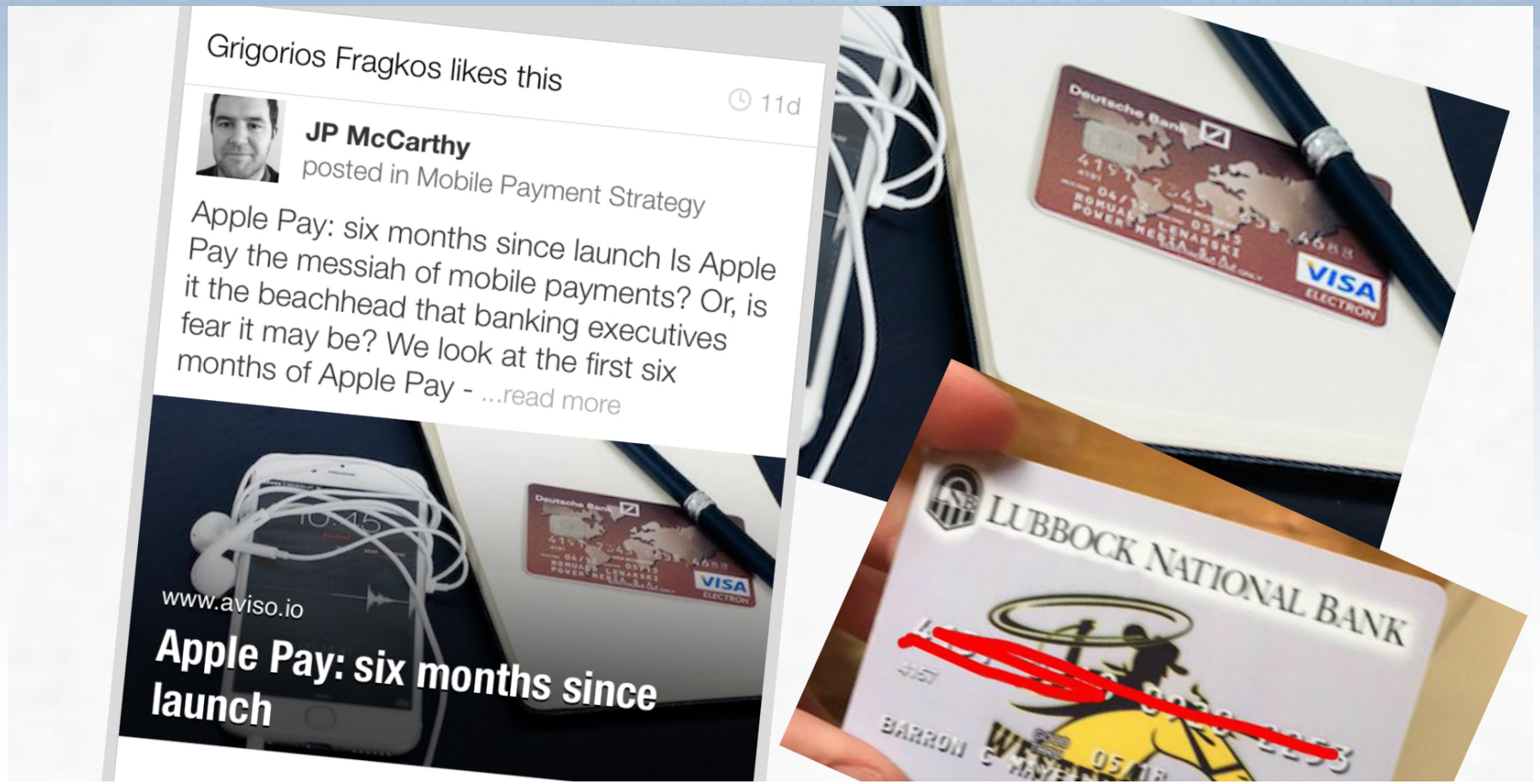
We need Cards..



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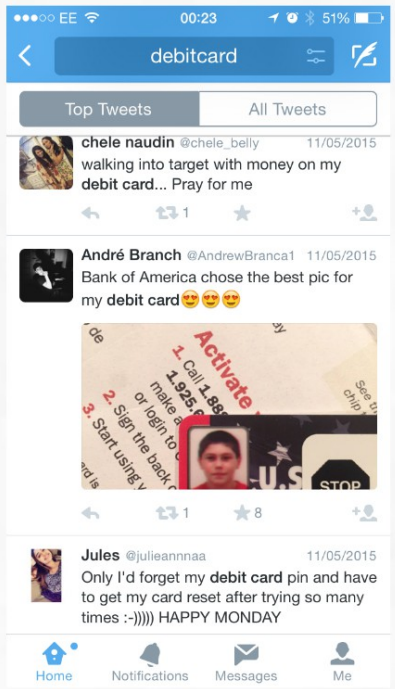

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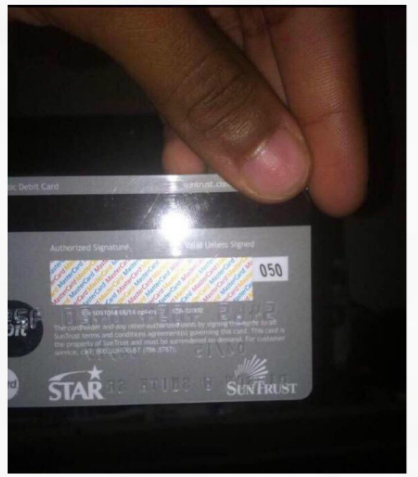
We need more Cards..



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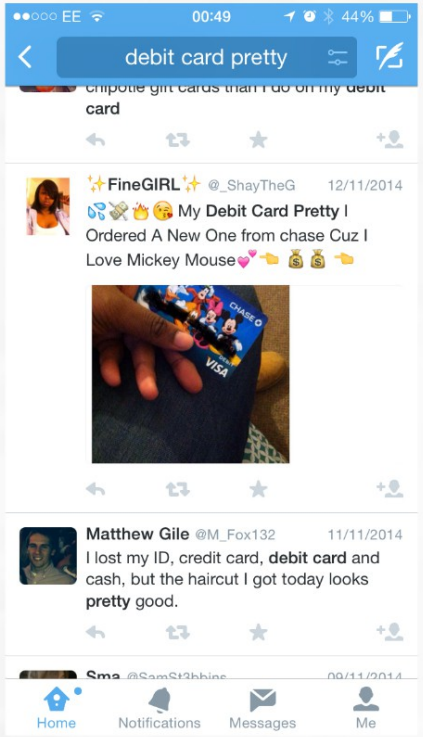
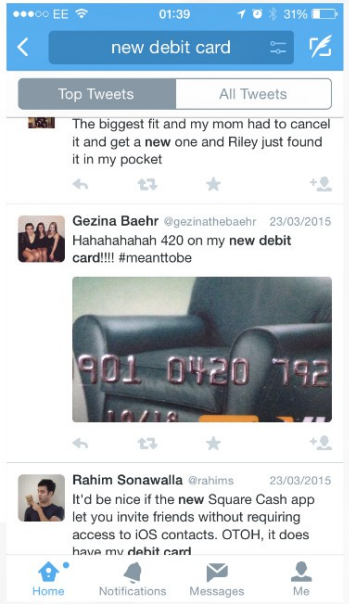
We need more Cards..





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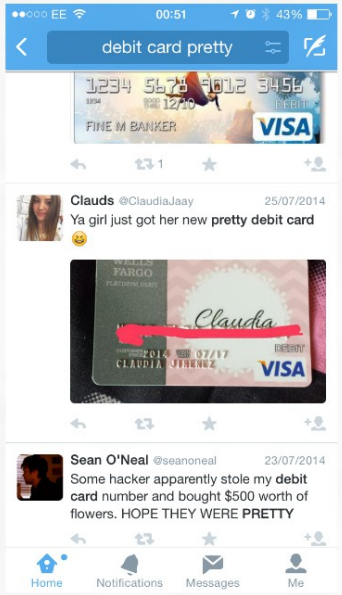
We need a few more Cards..



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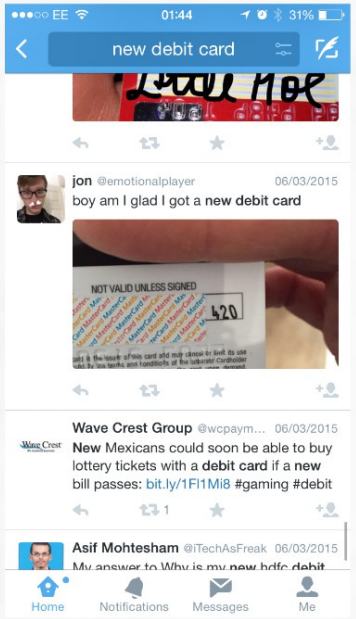
We need a few more Cards..



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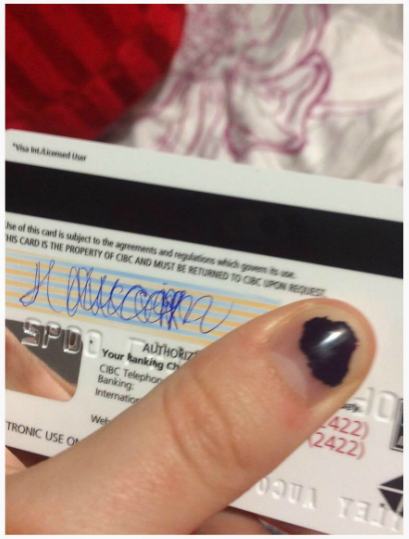
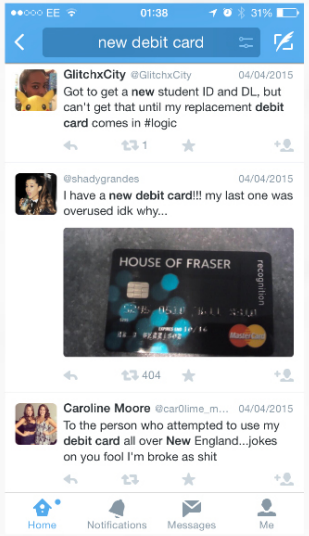
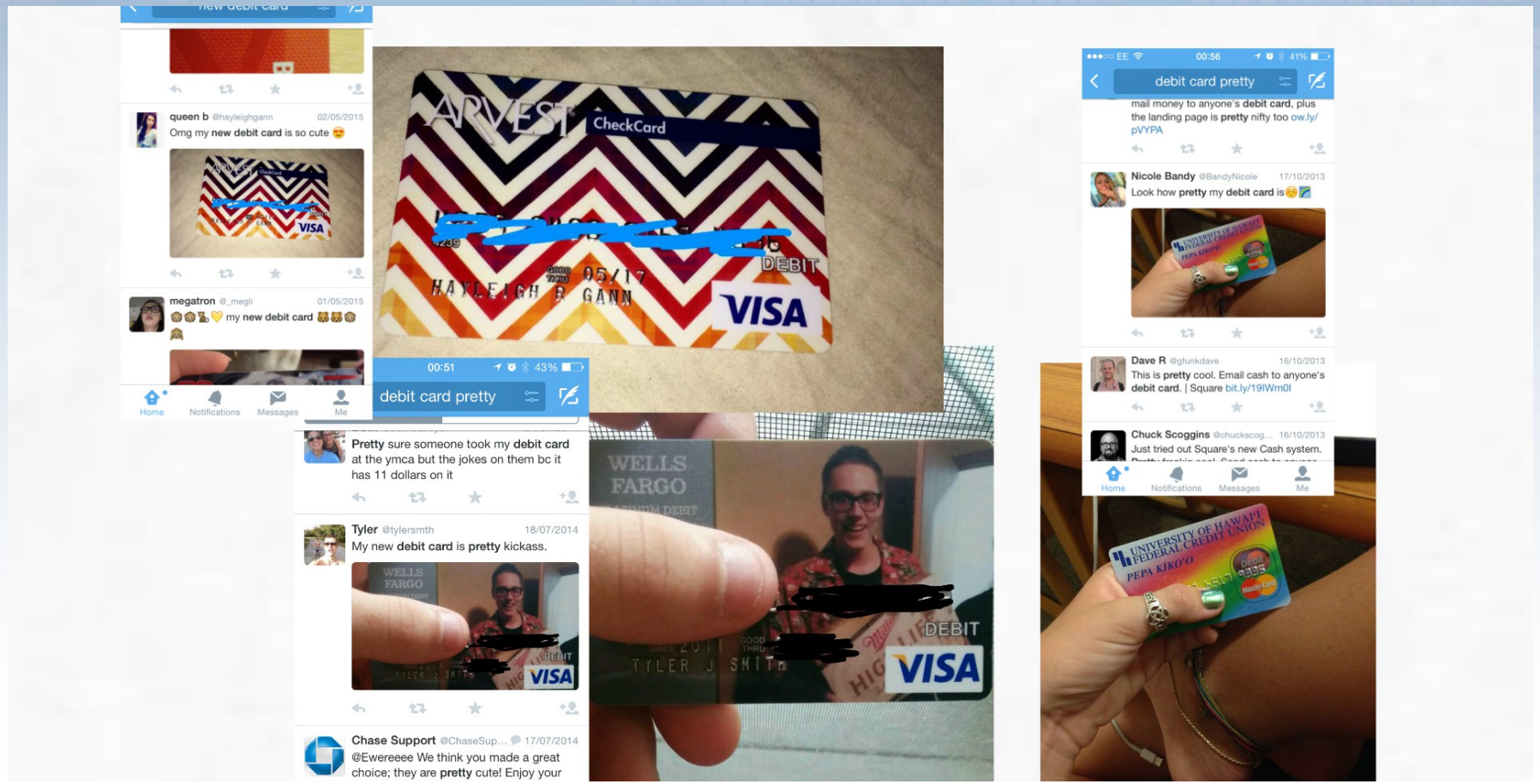
My precious..





My precious..



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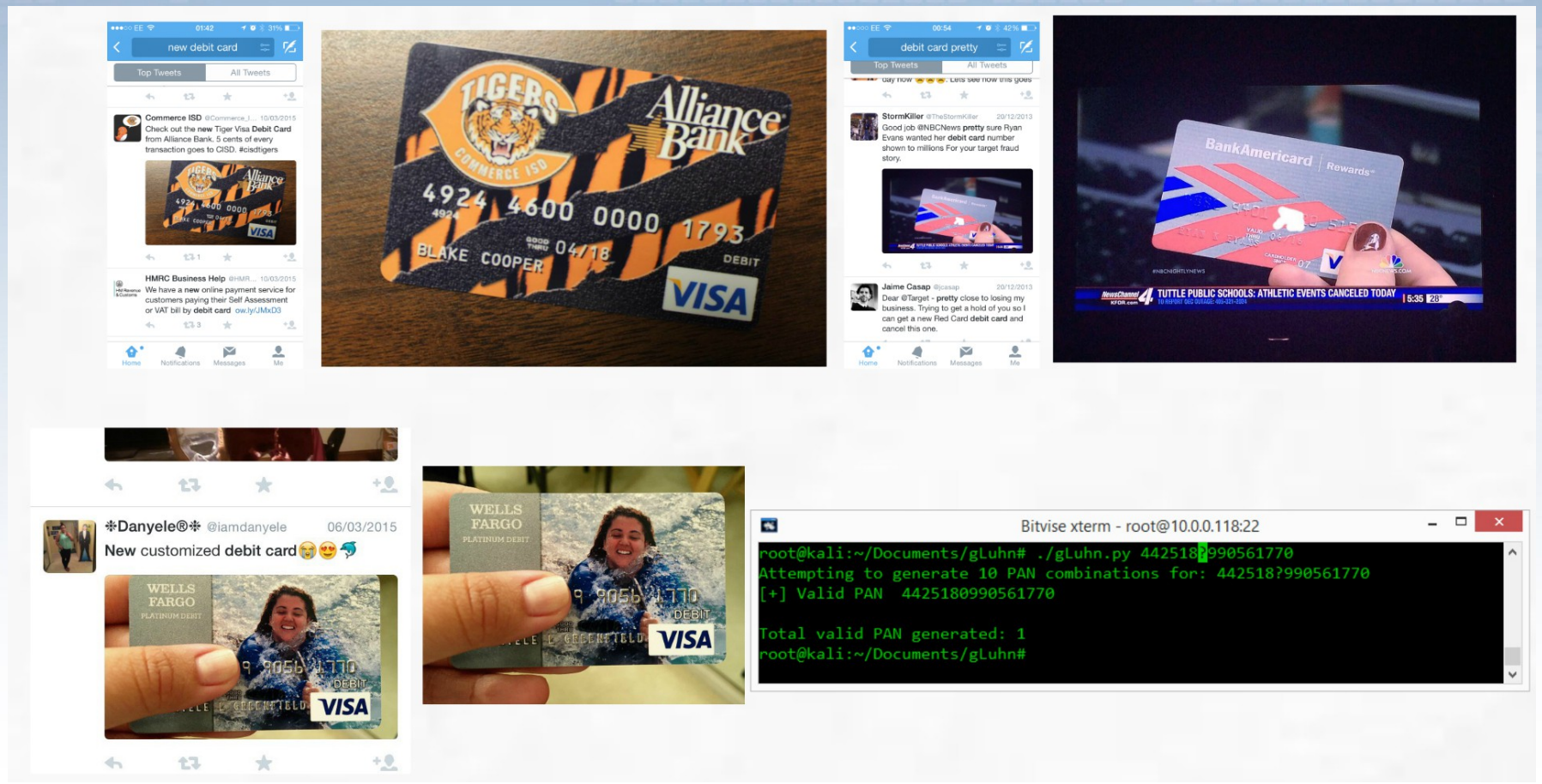
Regenerating the hidden digits..



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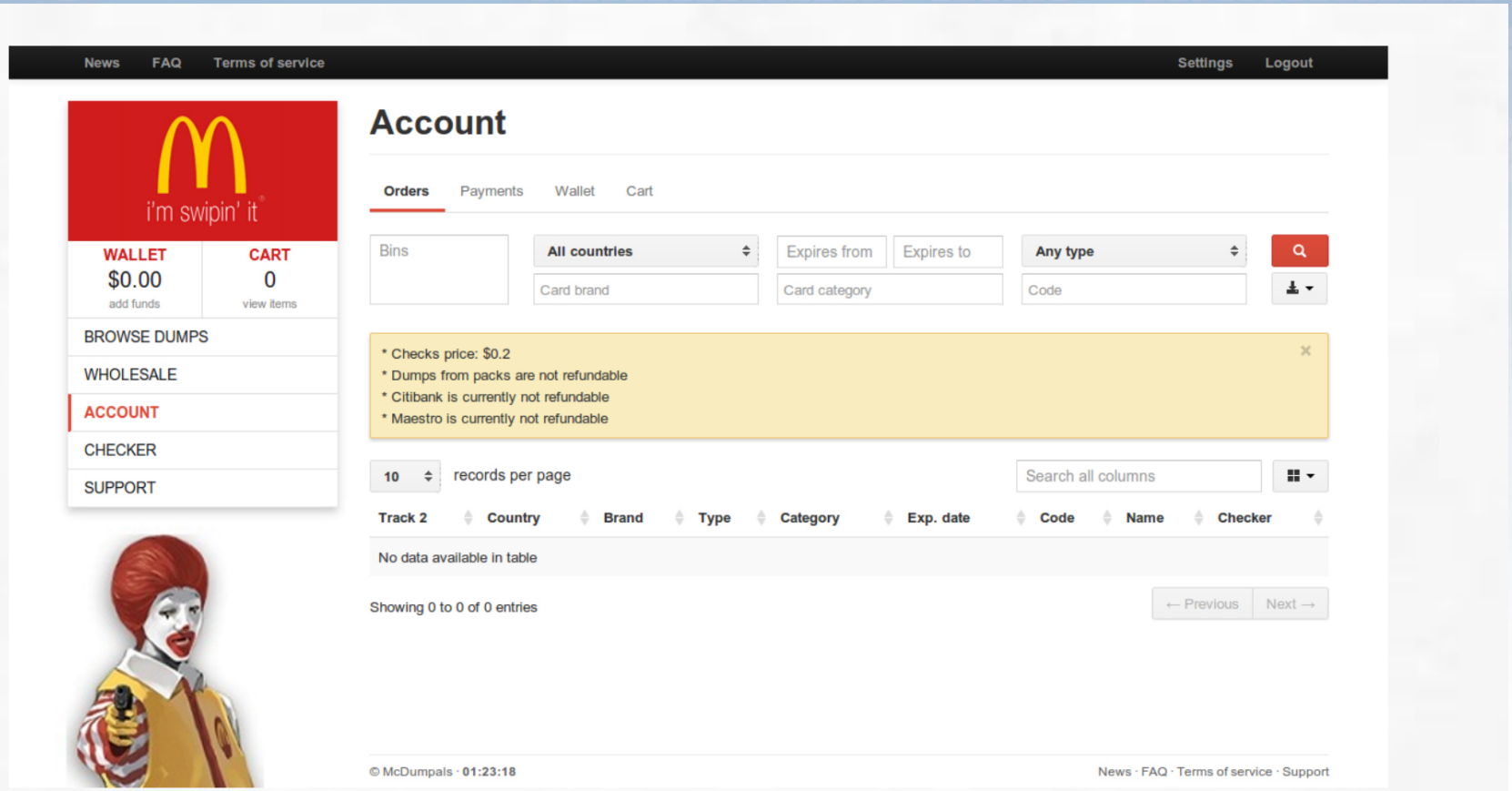
McDumpals



Moving to Virtual Terminals..

Writing a memory scraping POS malware?
Do they have to? ..once they get to know the system(s)?

#POSmalware

Virtual Terminals

- Software applications.
  - Provided by the Payment eco system, such as the Acquirer, Payment Service providers, and more.
  - VT can work without a POI connected to it.
  - Difference between ECR (ePOS) and VT; The ECR doesn't work without a POI.
  - You can key-in the card details on a VT
  - VT software needs to be PA-DSS compliant (according to PCI), while the ECR is only being checked if it stores CHD (!)

Penetration Testing for PA-DSS

- The main objective is to identify if it is possible to get your hands on the CHD.
  - SQLi or any other types of injections
  - Buffer Overflows
  - Cryptographic storage
  - Insecure Communications
  - Improper Error Handling

Threat Modeling

- Assessing the logic of the VT and look into the payment process from a malicious “merchant's” perspective.
  - A repeatable process to find and address all threats to your product.
  - The earlier you can start the better, with more time to plan and fix.
  - Must identify the problems when there is still time to fix them (before the ship day).
  - Third-Party Components & S/W Development Life Cycle (SDLC).
  - End Goal: Deliver more secure products.

At a first glance..

- Possible to modify the configuration files
  - One of the easiest tricks to demonstrate this was to change appears on the POI screen.

At a first glance..

- Possible to modify the configuration files
  - By the way, these new types of POI devices are interesting. They can communicate with the VT via Bluetooth if needed, while being powered over USB.

At a first glance..

- Possible to modify the configuration files
  - Each device comes with a different pairing key.

VT identifiers

- How do they distinguish between merchants?
- Each VT has “identifiers”.
- Based on the “identifiers”, payments are settled against the correct merchant.
- Editing however the “identifiers” in the configuration files messes with the encryption key, thus the encrypted header is not valid when a payment needs to be sent, and the transaction cannot be completed.

Anticipating shifts in fraudulent activity..

An alternative scenario to POS malware..

#POSmalware

Thinking outside-of-the-box

- Internet shoppers are expected to spend £748m on Boxing Day (£519,000 a minute)
- So, what you will need:
  - A valid Merchant ID
  - First year programming skills
  - Know how to cover your tracks
  - Think outside-the-box, focus on the money, not the card numbers!
  - Have attended this presentation!

Thinking outside-of-the-box

Thinking outside-of-the-box

- Last but not least:
  - Have attended this presentation!

Getting the job done

- You could create & spread malware that can:
  - Change the “identifiers” on every VT
  - Delete the encrypted header file
  - Reboot the VT application
- Covering your tracks by:
  - Change the “identifiers” to what it was.
  - Delete the encrypted header file
  - Clean the LOG file & Reboot the VT application

Delivery method

- Spread undetectable malware:
  - Much easier than one might think.
  - Activate it on.. Boxing Day / Black Friday?
  - Simply wait for the money to be settled to your bank account.

Bonus Round

- If the VT is written in JAVA
- Get the POS into asking you to Key-in the card:
  - Enter Card Number as normal
  - Add 70 years to your expiration date
- Alter the VT date by adding 70 years:
  - Perform any transaction you like

Conclusions

- Security is an ongoing process and the **Payment Card Industry** enforces compliant for a good reason.
- Cybercriminals are not better than **YOU**.
- It is easier to break things than fix stuff; it needs **a security mindset to keep things secure**.
- Cybercrime pays until you get caught.
- If you break the law, **you are going to get caught**!
- Technology is changing fast & won't be long before **you get caught**.

One last set of tips..

- Educate merchants **not to leave the POI unattended** at any time.
- To stay ahead of cybercriminals **consider such scenarios** & ensure you anticipate / can recognize, such **fraudulent activity in real-time**.
- Consider **threat modeling exercises**.
- If you **demagnetize your mag-stripe**, you cannot withdraw cash.
- You may **remove the CVV** from your card, if you memorize it.
- **Don't put a photo of your card online!**
- Use **RFID block: sleeves, wallets, cards**.

Time for Questions!

Thank you for your attention

#LetsGoShopping

 **@drgfragkos**