Robbing Banks: Easier Done Than Said

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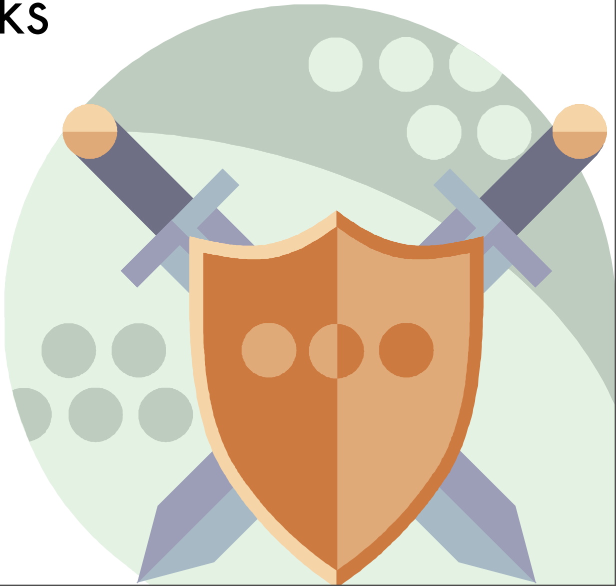

Introduction

- Foreword: we are NOT criminals
  - Attack always performed with full documented contract
- Goal of attacks: know if the financial institution is affected
  - Risk gets analyzed and fixed if necessary
- Goals of this presentation
  - Increase awareness of typical vulnerabilities
  - Most of it backed-up with real stats
  - Provide concrete solutions
  - Rant about some old technologies

Bank Robberies By Any Mean

- Why banks?
  - They have money to steal… lots of it!
  - We've all seen enough bank robberies movies…
  - …or "hack the bank" movies

- What's new?
  - The variety of means to attack
  - The lack of knowledge about these potential attacks

Bank Robberies By Any Mean

(cont'd)

- Physical bank robberies
  - Either rob the bank coffers or the fund transfer truck
    - Dangerous
      - you could get shot
      - you could get recognized
    - Money may be "marked"
    - Money may be "tracked"
    - Difficult to walk around with a million dollar discretely...

Bank Robberies By Any Mean

(cont'd)

- ATM Attacks
  - Attack the bank-side ATM processor
  - Attack the ATM OS
  - Card duplication
- Network Attacks
  - Hack into the bank's network
- Direct Application Attack
  - Hack into the bank's applications

Bank Robberies By Any Mean

(cont'd)

- Value added Partner Services' Attacks
  - Attack loan sales agent
  - Attack bill payment portals
  - Attack payment gateway applications
  - more...
- Insider Accomplice Attacks
  - helps an attacker gain enough information to perform online attacks

Bank Robberies By Any Mean (cont'd)

- Banks used to have a simple closed environment
  - As payment services grew, banks had to open-up
    - ATM
    - Credit Card, international networks (VISA, MasterCard, Plus, Cyrus, Maestro, etc...)
    - SWIFT
    - Intra-country bank debit network (e.g.: NETS/ATM5 in Singapore, CB in France, JETCO/UnionPay in HK)
    - Phone banking
    - Centralised cheques processing
    - Internet Banking
    - Mobile Banking
- Now the environment is extremely complex!!
  - ➡ all these services create new avenues for frauds

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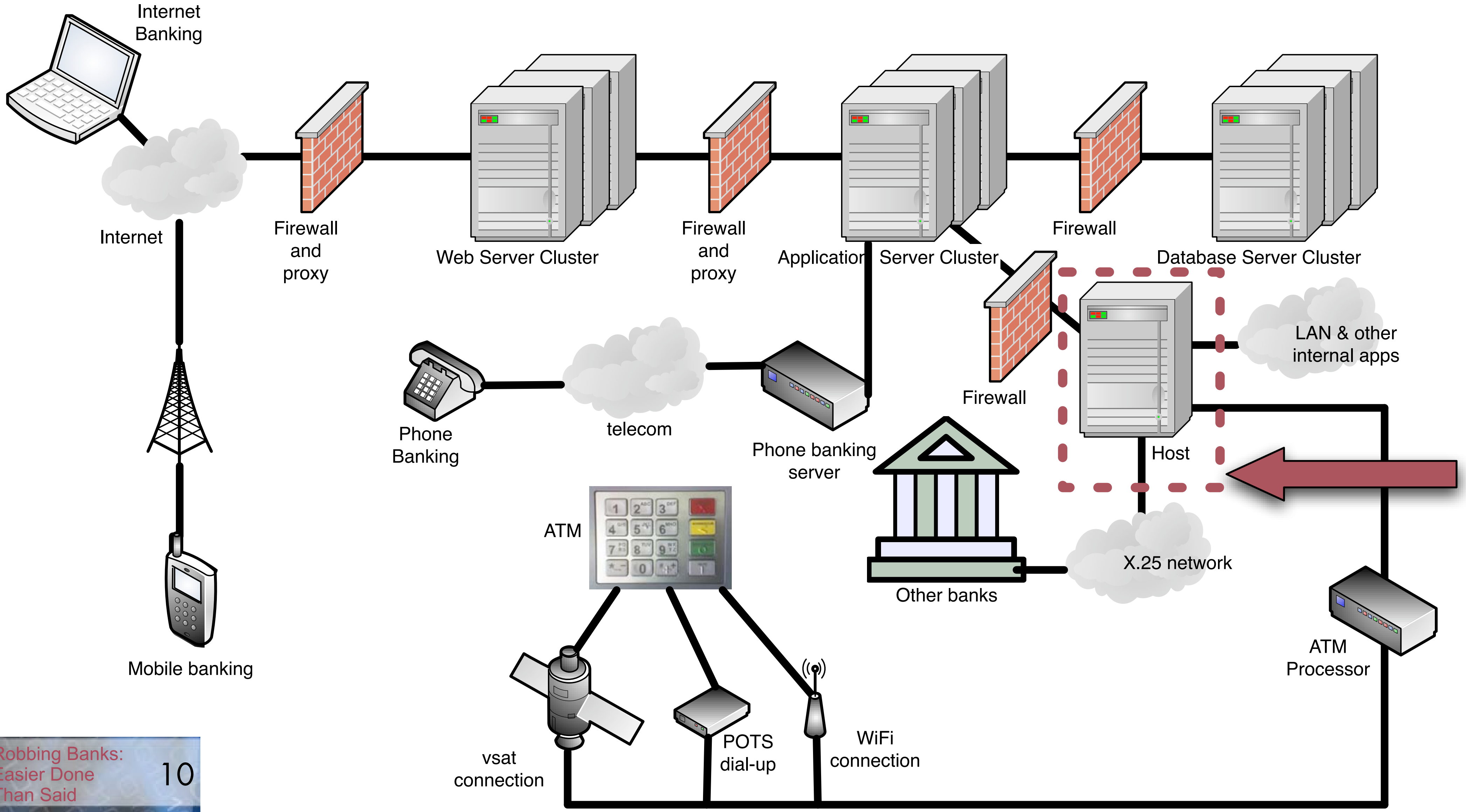
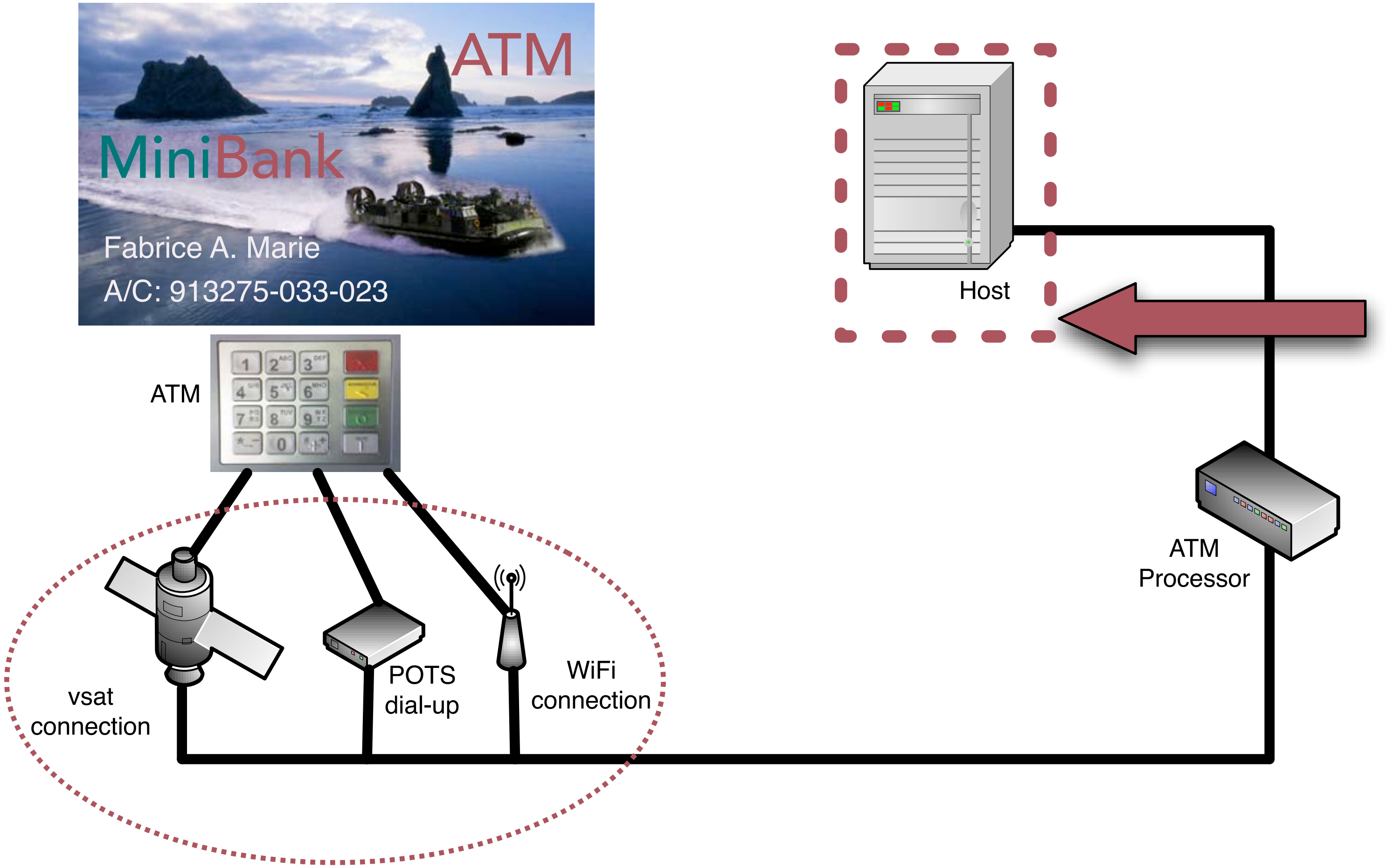
Bank Robberies By Any Mean (cont'd)

- The foundation of a bank is its "host", its mainframe
  - It is the one that perform all the actual money movements
- All services need direct or indirect access to the host
  - Attackers no longer need to point a gun to perform a robbery
    - ➡ robbers just need to use the services in "unusual" ways

Bank Robberies By Any Mean (cont'd)



ATM Attacks


ATM
MiniBank
Fabrice A. Marie
A/C: 913275-033-023
ATM
vsat
connection
POTS
dial-up
WiFi
connection
Host
ATM
Processor

ATM Attacks

(cont'd)

- An ATM performs money transactions for a client
  - Uses a unique ATM card and the user's PIN for authentication
- ATM cards are simply magnetic cards
  - An attacker needs a $ 5 magnetic card reader to copy the card

➡ ALL magnetic ATM cards can be copied

- Some banks use an invalid CRC so some advanced card reader fail
- However, cheap card readers will read the card, and copy it with the very same CRC error
- Cheaper hardware is better!

ATM Attacks
Card Duplication

- A lot of ATM frauds recently in the APAC region
  - Probably other regions as well
  - Full fraudsters syndicates
- The fraudster installs a thin card reader in front of the real ATM's card reader
- And a pin-hole camera above the PIN pad
  - ➡ Fraudster get all the ATM and credit card numbers and their respective PINs.

ATM Attacks Card Duplication (cont'd)

- Most banks protect their ATM against this kind of attacks
  - Camera can record the face of the fraudster who installs the equipment
  - Special card reader slot that make attaching an additional card-reader before the real card reader physically impossible
- What about other machines not owned by the bank?
  - Overseas ATMs
  - Merchants' card readers
  - Automated machines (ticketing, bill payment, etc...)
  - ...

ATM Attacks
“Network” Attacks

- ATMs have to be connected to the bank in real-time to perform the transactions
  - Verify balance
  - Deduce money when fund transfer performed
  - Deduce money when money withdrawn
- Connection technology depends on a lot of factors
  - Cost
  - Location
  - Legislation and compliance
  - Bank’s head-office usual way / preference

ATM Attacks “Network” Attacks (cont’d)

- ATMs use various connection types
  - POTS dial-up
  - Leased lines
  - vsat connection
  - WiFi connection
  - Ethernet connection
- ATMs use various communication protocols
  - SNA over SDLC
  - TC500 over Async
  - X.25
  - TCP/IP over Ethernet
- The message format is generally a home-brewed version of ISO 8582

ATM Attacks
"Network" Attacks (cont'd)

- Typical problems with ATM connections?
  - Lack of encryption / Weak encryption
  - Lack of authentication / Weak authentication
  - Connection not physically secure
- Typical problems with ATM protocols ?
  - Complex doesn't mean an attacker won't know it
    - Still a lot of X25 experts (in France/Italy for example)
    - The complete SNA network stack on Linux was written by a 21 year old teenager in USA in 2001
  - Protocols not properly implemented
    - Recommended security settings
      - ignored / misunderstood / badly implemented

ATM Attacks
“Network” Attacks (cont’d)

- An attacker plants a device between the ATM and the network
  - Phone connector
  - X.25 pad
  - Ethernet mini-hub
  - vsat and WiFi direct association
- Then he can start wiretapping the traffic
  - Hopefully encrypted
  - Most of the time weak encryption ➡ record all transactions
    - Replay attack almost never works
      - However, direct modification of the request sometimes work
        - When the home-brewed ISO 8582 message does not follow the security recommendations

ATM Attacks
"Network" Attacks (cont'd)

- Once physically on the same network as the ATM, the attacker can try to hack into the ATM
    - It's a networked computer after all.
    - Most are running EXTREMELY old version of windows these days
        - Plant a Trojan onto the ATM itself
        - Trojan could record ATM/Credit Card information including PIN
        - Trojan could arbitrarily dispense money
            - Dispense less ?
            - Dispense more?
            - Not dispense and still decrease balance?
            - Retain the card?
            - Overwrite the card with the previous client card's content?
            - more fun stuff...

ATM Attacks
"Network" Attacks (cont'd)

- Once physically on the same network as the ATM, the attacker can try to hack into the ATM Processor (bank-side)
  - It's a networked computer after all.
  - Most are running archaic operating systems that are seldom patched-up
- ATMs often share the same key to authenticate to the bank
  - Either steal the key using the trojan method above
  - Or physically steal the ATM machine
    - Needs 2 strong gangsters, and a pick-up truck.
  - Then you can pretend to be an ATM when talking to the ATM processor of the bank, and perform valid arbitrary transactions

ATM Attacks
“Network” Attacks (cont’d)

- Maybe your bank is protected against this kind of attacks ...
  - ... or so you think... !!!

- What about other...
  - Banks
  - Bank networks
  - Point of sales
  - Automated machines

ATM Attacks “Network” Attacks (cont’d)

Real Life Example 1:

- A leading bank in Bangkok, Thailand
  - ATM in the shopping center…
  - Is plugged to the UPS
  - And to the X25 modem
  - Without any temper-proof cover!!
  - No security camera either
    - Attacker could unplug the ATM and plug his laptop to the X.25 pad, then wiretap the traffic
    - Attacker can modify the traffic on the fly
    - Attacker can attack both sides of the connection (ATM / ATM processor bank-side)

ATM Attacks
“Network” Attacks (cont’d)

Real Life Example 2:

- A few leading banks in Bali, Indonesia
  - ATM nearby the beach…
  - Is connecting to the near-by branch of the bank using WiFi without encryption
  - Another one is using vsat to connect to Jakarta (probably without encryption)
    - Attacker can pear with the network in both cases and wiretap the traffic
    - Attacker can modify the traffic on the fly
    - Attacker can attack both sides of the connection (ATM / ATM processor bank-side)

ATM Attacks
"Network" Attacks (cont'd)

Real Life Example 3:

- A leading bank in Singapore
  - ATM is securely protected in a hard-shell with security camera
  - 3 meters away (far from the camera viewpoint) is the phone cable connecting ATM ↔ ATM processor bank-side
    - Attacker can pear with the network in both cases and wiretap the traffic
    - Attacker can modify the traffic on the fly
    - Attacker can attack both sides of the connection (ATM / ATM processor bank-side)

ATM Attacks
“Standalone” Attack

Real Life Example 4:

- A bank in Taipei, Taiwan
  - Withdraw $ 100 from the ATM
  - Take 80
  - Leave 20 (the ATM will take it back)
  - The ATM will refund your account $ 100
    - You just stole $ 80

ATM Attacks Solution (short)

- Solution is technologically simple
- But costly
  - Need to update all EFTPOS in the operating country
  - Need to update all automated machines that support the card
- Problem:
  - Security of ATM is as weak as its weakest link
    - If card works overseas, then the card has to accept lower standards so it can be used there

ATM Attacks Solution (long)

- Use smart-card technology + strong encryption
  - Latest revisions are unbreakable so far
    - Impossible to copy
    - Impossible to operate without the card / brute-force
- Use strong encryption for privacy and authentication
  - Each ATM terminal its own key
- Harden your machines
  - Secure the ATMs OS like you would do with any other machine
  - Secure the ATM Processor OS like you would do with any other machine

ATM Attacks Solution (long)

(cont'd)

- Use 2-factor authentication for big transactions
  - 2nd factor can be a hardware token, sms, private question etc...
- Give a phone call for even bigger transactions
- Enforce geo-location conflicts
  - If user just withdrew in Singapore he can't be in Hong Kong five minutes later to withdraw again.

Credit Card Frauds

- Credit card is an old and INSECURE technology
  - Some new secure standards
    - BUT still compatible with the insecure old standard
  - ➡ Stealing the card and forging the card’s signature works until today
  - ➡ Or worse, buying an item by phone and giving someone else’s card information works too
- Credit cards have the same problems as ATM
- … plus their own! (ATM is therefore more secure)
  - plenty of attacks, we will just see one

Credit Card Frauds Simplest Attack Ever

Easiest attack

- Relies on the fact that merchants are … careless
- Counterfeiting signature is trivial

Especially…

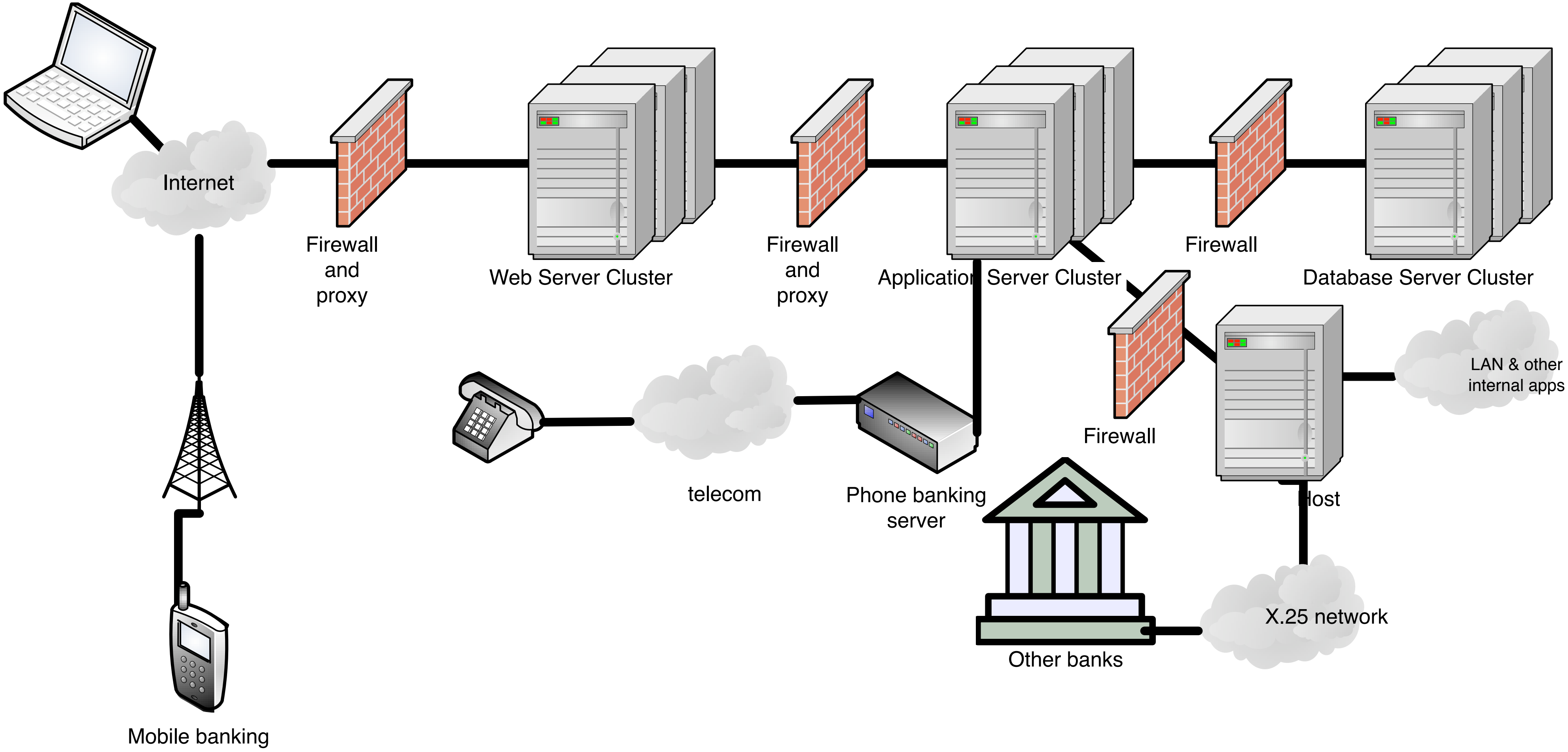
… when the merchant does not check the signature !!!

- Just use your credit card (no mistake… ~~not debit card!~~)
- Buy dinner to a few friends
- And sign something totally unrelated (or let your friend sign…)
- Refuse to pay the bank!
- Bank will check, the signature will not match yours, the bank will reverse the transaction and the merchant will lose money!!!

Credit Card Frauds
~~Solution~~

- Enforce higher standards of security
  - … internationally
  - Not going to happen tomorrow
- Use standards like in France for example
  - Credit card is a smart-card
  - PIN always necessary while in France
  - Overseas the lower level of security applies
    - Magnetic stripe
    - Signature
    - So even French cards can be used for frauds
- Hence the need to drop the support for lower level of security…
- And create ONE new SECURE international standard

Network Attacks



Network Attacks

(cont'd)

- Are complex
- Used to be very difficult the last 5 years
- But as banks offer more services...
  - ...they need to open up their network!!
- Anything goes
  - Penetrate into the DMZ, and plant a sniffer
  - Penetrate into the LAN though a VPN/Dial-up
    - and do everything from there
  - Penetrate a partner that has privileged access to bank network
  - ...

Network Attacks

(cont'd)

- DMZ attacks are very unlikely
  - virtually the best protected place in the bank
- LAN attacks are easier
  - VPN attacks are the most straight forward
  - Even better with a dial-up or a rogue WiFi
  - Social engineering
    - Courier a trojan on an "interesting" CD to an IT guy in the bank
    - He will DEFINITELY open the CD in his desktop
    - Trojan will connect to attacker launch pad and await commands
    - Even better, malware/virus detectors will not detect it
      - because it's carefully custom made

Network Attacks

(cont'd)

- While banks network are secure...
- ... their partners are not necessarily
- Attack the partners!
  - stock brokers
  - bank loan sales agencies
  - sometimes even insurance companies
- Bank connected via global X.25 network?
  - even better

Network Attacks Solution

- Secure your bank network like you secure your DMZ
- Prevent staff from installing rogue WiFi
- Prevent staff from installing rogue dial-up
- Don’t use X.25
  - Internet or VPNs are cheaper and better understood
- Don’t trust your partners in terms of security
  - separate yourself from them with a very strict firewall
- Secure ALL passwords on the VPN
- Segregate your internal network in smaller areas
  - enforce internal policies with internal firewall with strict rules

Direct Application Attacks

- Banks have a lot of internet facing applications
  - Consumer Internet Banking
  - Enterprise Internet Banking
  - Mobile banking
  - Reward program
  - Stock investment
- Each and every of them is an avenue for frauds

Direct Application Attacks

(cont'd)

- Bank Applications attacks are generally simple
  - If not simple, then the network equivalent attack would be worse!
- Lack of skills in the application arena
  - Developers/Architects/Programmers are under-skilled
  - Lack of funds for the application
  - Lack of funds for the application security testing
- You have control over your network, but not over your application
  - Network uses standard components
  - Application is a monolithic peace of software

Direct Application Attacks

(cont'd)

- Requirements for attack?
  - Become a customer of your bank
  - Username and password given to the attacker/customer
- Tools?
  - Various interactive web proxies
    - Burp
    - WebScarab
    - Paros, etc...
  - Decompilers for .Net & Java
  - Decoders and encoders

All free and easy to download

Direct Application Attacks

(cont'd)

- Basic Concept:
  - Fill in the form
  - Intercept the request
  - Modify the request without limitation
- Sometimes attacks are hard
  - Lots of things to modify
  - 6th sense / previous knowledge helps
  - Complex interlinked data structures makes it harder
    - The developer gets lucky sometimes
- Hard means a dedicated knowledgeable attacker will still manage, albeit in a longer time!!!
- Sometimes it's super easy
  - Change one field and enjoy!!

Direct Application Attacks

(cont'd)

Logic Flaws

- "Using an existing functionality in an unauthorized or malicious manner in order to get what we want"
- Attackers want money so...

- Impact:
  - ... they'll help the attacker rob the bank
  - ... or the bank customers
  - Loss of confidentiality
  - Usually outright frauds in general

- When it comes to stealing money
  - they perform better than SQL Injections and other conventional web application attacks

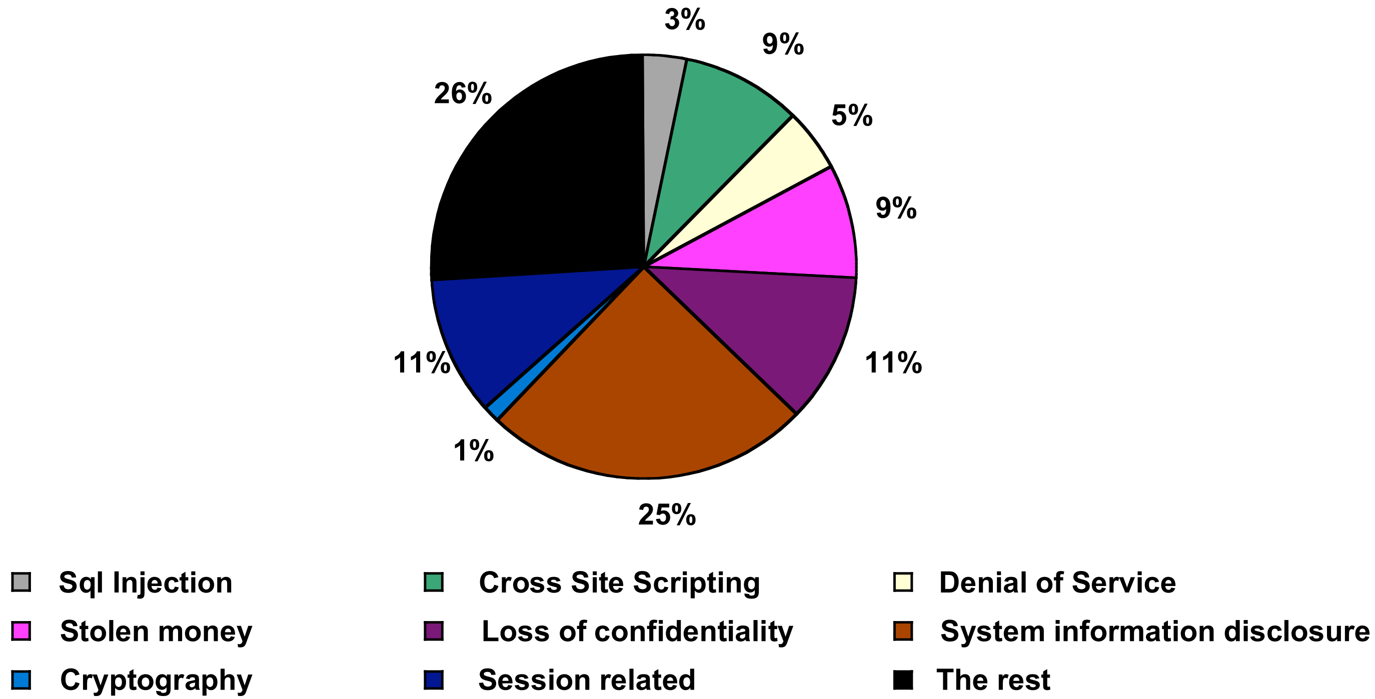
Direct Application Attacks

(cont'd)

- Frauds we commonly find on internet banking applications:
  - read other customer's bill payments
  - read other customer's personal information
    - very useful as the base for more advanced attacks
      - identity theft
  - stealing money using various transfer functionalities
  - direct bank transfers among others
  - buy shares at a discounted price
  - avoid transaction fees
  - various payment gateway systems replay attacks
  - destruction of transaction records
  - modification of other customer personal details
    - very useful as the base for more advanced attacks
      - user impersonation

Direct Application Attacks

(cont'd)



Internet Banking Applications
Breakdown of vulnerabilities by category

Last 17 internet banking applications we audited (in 2005)

Applications we could steal money from: 100%	Applications we could steal personal information from: 100%	275 vulnerabilities 429 beta scripts 341 unnecessary files

average: **16 vulnerabilities** per application

Direct Application Attacks

(cont'd)

- Application Security Testing CANNOT be automated
  - Automated tools will only find generic attacks
  - Automated tools will not know about logic flaws
    - and logic flaws are the most dangerous ones
  - Automated tools may assist an experienced pen-tester
  - but will never replace a professional

Direct Application Attacks

(cont'd)

Service Oriented Architecture

- Buzz word for a central WebServices server
- Which is another buzz word...
  - Basically a central, insecure, SOAP server
- Usually uses weak authorization
  - several application use one username / passwords
  - therefore a credit application could potentially
    - transfer money
    - instead of approving a credit
- SOAP makes the attack way easier for a network based attacker that would otherwise have to craft the transaction by hand

Value Added Partner Services' Attack

- Large banks have a few partners
  - stock brokers to invest shares
  - loan sales agencies to sell bank loans
  - pawn shops to secure loans
  - car dealers to sell bank loans
  - payment gateway processors
  - bill payment service companies

Value Added Partner Services’ Attack (cont’d)

- Partners have to have access to the bank
- Either to dedicated specialized bank applications
  - open only with VPN
  - or firewall ACL
- Or to the bank SOA
  - open only with VPN
  - or firewall ACL

Value Added Partner Services’ Attack (cont’d)

- However partners have less stringent security rules
- Their applications are more insecure
- Their network are more insecure
- Yet they have a trusted access to the bank

- Trivial to use a partner as a launch-pad to defraud money from the bank or its customers

Value Added Partner Services' Attack (cont'd)

- Visa is already forcing their partners to secure-up
  - good, but is it enough?
- Some banks are forcing some of their partners to secure-up
  - seldom happens. Yet if it does, is it enough?
- Banks should force ALL their partners to secure-up

Insider Accomplice Attack

- The threat always come from inside
- Bank LANs are never encrypted
- Internal networks are seldom properly segregated
    - even when they are since they are not encrypted...
        - ... an internal attacker can easily recover usernames / passwords
            - and masquerade as an admin / authorized user to fraud
            - and sell them to organized crime

Insider Accomplice Attack

(cont'd)

- Banks run a LOT of applications for internal use only
  - Credit management applications
  - Investment applications
  - Identity management applications
  - Payroll applications
- The list is unbelievable
  - Most of them are weaker than the internet facing ones
  - Which were already quite weak
  - All the usual attacks apply (SQL injection, command execution, and the whole lot)

Insider Accomplice Attack

(cont'd)

- By getting a few relevant usernames / passwords
  - using very basic sniffing techniques
- And insider attacker could
  - authorized without authorization a loan an attacker requested
  - spy on investments and provide "insider trading" information to an attacker
  - increase an attacker credit limit
  - wipe an attacker audit-trails or errors logged
  - perform all sorts of interesting, undetectable frauds
    - they will be detected too late
    - the wrong person will be blamed

Pre-Conclusion

- If you are a bank and organized crime really wants your money
  - they will recruit good hackers
  - they will pay the right insider
  - and they will definitely succeed
- That would be entertaining for the rest of us
  - could be turned into a “real story” movie after that

Conclusion

- You protect your human tellers
  - so protect equally your ATMs machines and network
- You put heavy firewalls and money in network security review
  - So put strong controls in your applications
  - and test them adequately as well
- Use strong encryption at EVERY level
- Force your partners to secure up to your level
- When organized crime will realize their "opportunity cost" they will definitely turn to cyber-robberies
  - by then you better be ready

Links

- Hacking Internet Banking Applications
  - HITB 2005
  - Available here:
    - http://www.packetstormsecurity.org/hitb05/BT-Fabrice-Marie-Hacking-Internet-Banking-Applications.pdf
- Application based Intrusion Prevention Systems
  - HITB 2006
  - Available here:
    - http://conference.hitb.org/hitbsecconf2006kl/materials/DAY%201%20-%20Fabrice%20Marie%20-%20AIPS.pdf

QUESTIONS ?

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