Computer Security and Privacy in Finance

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iCIS | Digital Security
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Outline

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Where we are, so far

Financial crime in NL in M€ (Source: Betaalvereniging)

Activity	'92	'10	'11	'12	'13	'14	'15
bank robbery	570	26	7	4	?	?	?
internet banking	—	10	35	38	9.6	4.7	3.7
bankcard skimming	—	20	40	29	6.8	1.3	±0

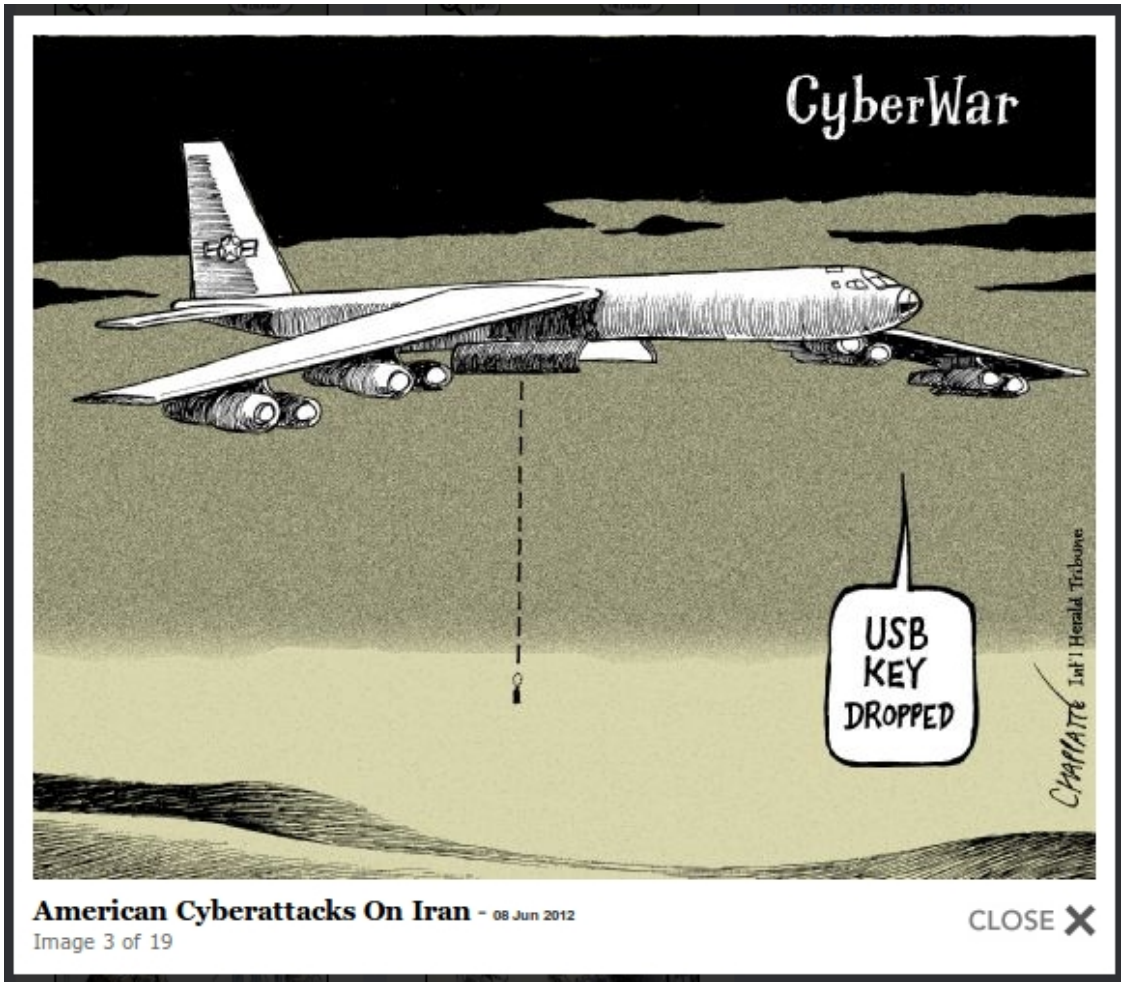
Remarks:

- You're an old-school loser if you're still planning a career as bank robber
- *Bad guys have gone digital*, in fraud, blackmail, sabotage, espionage
- New forms of financial fraud constantly appear, like: asking people to send in their bank card, or attacking cash machines
  - total fraud level is a bit higher in 2015 than 2014

“In five years half of all crimes are carried out by cybercriminals”

PG Gerrit Verburg, Nieuwsuur 15 juni 2016

Warfare has gone digital: a picture says it all



(© Herald Tribune)

Wars and Sciences

- **WWI** was the chemists' war, with the use of poisonous gases

- **WWII** was the phycists' war, with the atomic bomb

- **WWIII**, if ever, will be the computer scientists' war

Computer security is interdisciplinary

- **Mathematics**: cryptology as basic toolkit for encryption, signing, authentication, etc.
- **Computer security**: the software, hardware, networks that make things work
- **Management / economics / psychology**: which incentives work?
- **Law / ethics / politics**: what is/should be allowed, esp. against cybercrime and for dataprotection

Societal relevance

- Traditional view:
  - computer scientists are architects of the digital world
- Modern view:
  - computer scientists are architects of the social world

Computer security and privacy issues can make or break developments in:

- communication
- transportation
- health care
- finance & insurance
- government *etc.*

What is *computer security* about?

Computer Security is about regulating access to (digital) assets

Key issues

- assets: the valuables that need protection
  - Eg. company secrets, or personal data (privacy)
- regulating access: involves
  - identification: who are you? / what are your attributes?
  - authentication: how do you prove this?
  - authorisation: what are you allowed to do

Implicitly there is a malicious attacker that is trying to get unintended access and to undermine your (computer) system

Own/group involvement in ICT-security & finance

- Security of bank cards: move from magnetic stripe to chip
  - now also: relay attacks on contactless payment cards
- Security of internet banking
  - e.g. protocol error discovered in ABN AMRO's random reader
  - authentication of customers and digital signatures
- Bitcoins and blockchains — see later
  - topic of nov.'17 blog at ibestuur.nl
- Payment Service Directive 2 (PSD2) — see later
  - topic of sept.'17 blog at ibestuur.nl

Betaalvereniging is paying a part-time (0.2) professorship on financial information security in Nijmegen — occupied by Eric Verheul

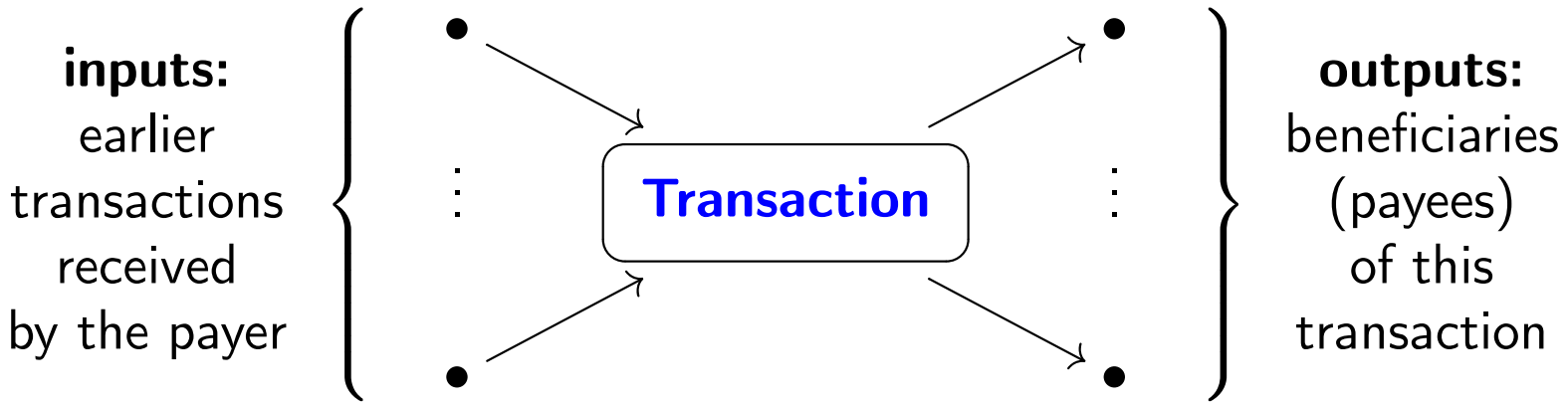
Where we are, so far

Bitcoins in action

Some relevant webpages:

- new, unconfirmed transactions or bitcointicker
- bitlisten.com for an artistic visualisation
- bitcoin value chart
- overview of various cryptocurrencies

Bitcoin transaction (commonly denoted as: tx)



- The sum of the bitcoin amounts in the inputs must exceed the sum of the amounts in the outputs
- The difference is the transaction fee, which is for the succesful "miner" (see later)
  - In practice a non-zero fee is needed to get processed

Bitcoin transaction arithmetic

- Suppose that Alice wants to pay 5 BTC to Bob, ...
- ...and that Alice has been payed herself in two previous transactions, one with 2.5 BTC and one with 4 BTC.

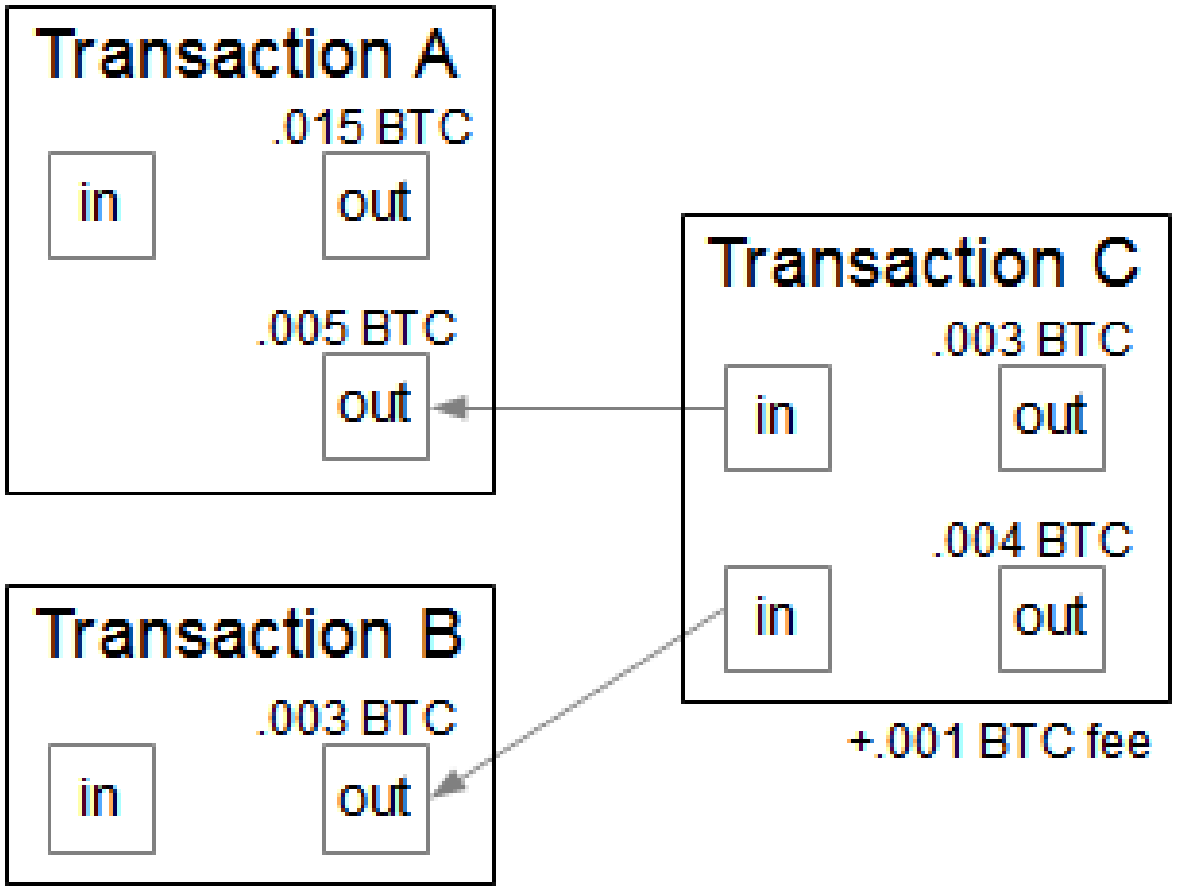
How to proceed?

- For the 5 BTC payment to Bob, Alice can use:
  - **inputs**: both these transactions, of 2.5 BTC and 4 BTC
  - **outputs**: 5 BTC to Bob, and 1,49999 BTC to herself
  - The transaction fee is thus:

$$(2.5 + 4) - (5 + 1,49999) = 0.0001 \text{ BTC}$$

- if 1 BTC = 8000€, this fee is 80 eurocent.

Transaction inputs, in a diagram



(source: Ken Shirriff's blog, feb. 2014)

Bitcoin mechanics (high level)

- A Bitcoin address looks like an arbitrary number, but is a hash of a public cryptographic key
- A user may have/generate/use multiple addresses
  - the addresses are all public, but you can hide the link between you and your addresses (eg. via mixers)
  - this provides (some) transaction privacy
  - using multiple addresses gives an additional level of obfuscation
- Basic cryptographic operations, like signing and hashing, ensure:
  - only owners of addresses can transfer from these addresses
  - a link between the current and previous transactions
- So-called miners collect unconfirmed transactions and put them in a block, that gets added to the blockchain
  - building a block involves solving a mathemtical puzzle
  - this puzzle requires huge computational resources (and energy)
  - the winner gets the transaction fees, plus a fixed amount

Some general remarks

- Bitcoin is far from being "green"
  - Recent claim: energy consumption of one bitcoin transation is enough for a normal house for one week
- Public authorities have difficulty coping with Bitcoin
  - mixed reactions (banning, tolerating, ignoring)
  - NL attitude (DNB/AFM): "there are risks"
  - the value is extremely volatile
  - transaction speed is too limited (max. 7 per second)
- Since Bitcoin hundreds of other cryptocurrencies have emerged
  - most well-known alternative is Ethereum
  - they have given rise to *Initial Coin Offerings* (ICO's)
- Not so much Bitcoin, but the underlying blockchain technology has become a complete hype
  - unsuitable for personal data, not only because of privacy
  - but also: data is not removable, which is legally required

Where we are, so far

Own involvement in PSD2

- Supervision of master thesis on this topic in 2016 [link]
- Invited presentation at DNB, at an internal PSD2 discussion session for board & directors (4/9/17)
- Online blog at ibestuur.nl, with title: *PSD2, een Europese strategische blunder* (published 12/9/17)
- Appearance in consumer programme Radar about PSD2 (23/10/17)
- Participant in expert hearing of Financial Committee in Parliament (15/11/17)
  - Opening statement: *welke malloot heeft dit verzonnen?*

Inbetween: various informal discussions with bank representatives.

Essentials of the PSD2 regulation (and abbreviations)

- Part of the European legal framework for the financial industry
  - intended to create a level playing field for FinTech startups
- Two new roles:
  (1) Account Information Service Providers (AISP)
  (2) Payment Initiation Service Providers (PISP)
- Banks are called: account servicing payment service providers (ASPSP)
  - they are obligated to cooperate with SPs = AISPs & PISPs
  - without discrimination and free of costs
- PSD2 contains accompanying requirements wrt. security of online payments and account access: "regulatory technical standards" (RTS)
- Structure of supervision on SPs:
  - EBA at European level — including security & data protection
  - National bank (DNB) issues permits
  - who have to cooperate with relevant authorities (AP, AFM, ACM)

Privacy is keeping information in context (Helen Nissenbaum)

- We naturally live in different contexts
  - home, work, sports club, in church, with friends ...
- We naturally want to keep information in context
  - what we tell to our doctor should not end up in a supermarket
- People get upset when contextual integrity is broken
  - recall anger: about selling customer financial data (ING), about speeding data ending up at the police (TomTom), about school children's performances in online tests ending up at publishers
- When explained like this, almost everybody cares about privacy
- The Google's and Facebook's of this world make us use the same identifier everywhere or track us via Like  and cookies
  - they break-up contexts, and destroy our basic privacy intuitions
  - Mark Zuckerberg: "Having two identities for yourself is a lack of integrity" 

PSD2 and data protection

- Business models of FinTech are based on personal data processing
  - data protection regulation is thus highly important
  - exit plan with data deletion now required by DNB
- GDPR requirements that are most relevant for PSD2:
  - user consent, based on objective, understandable information
  - purpose binding: data usage for requested purposes only
  - data minimisation: only data which is directly relevant to the service may be used
- Security breach notification to 'competent authority' (NCSC?)
  - but also NL data breach notification (to AP) applies

Some problems with PSD2

(1) The idea is to support "friendly" and innovative FinTech's
- in practice, the big-five will benefit most
- they get free payments and valuable consumer data for free!
- strategic blunder: also US social media companies should be forced to open up.

(2) PSD2 parties (PISP + AISP) may seek access 'via user portal'
- Germany payment service Sofort requires user's PIN code !!
- lame regulation compromise: only allowed as "fall back"
- much confusion, which will be exploited by criminals

(3) Who registers consent how?
- AISP can say to bank: this customer of yours has given me consent: now you must cooperate and hand over data
- banks want consent registration via their authentication means

Problems with PSD2, continued

(4) Who determines what is a service?
- can Google use your payment data to personalise maps: show only those restaurants that (Google thinks that) fit your budget?
- personalised advertisement and pricing may well lead to higher prices

(5) Personal "consent" to open up your bank account may be not be a free choice at all:
- e.g. when you want mortgage advice
- or get Visa, e.g. for entering the US

(6) Consent in itself is a very problematic mechanism in itself
- many people agree to anything, just to be able to proceed
- more consumer choice mostly benefits big-IT !!!
- still, free choice remains a powerfull mantra, just like innovation

Problems with PSD2, continued further

(7) National permits are valid throughout EU
- cowboys will seek entry point with least requirements
- intelligence agencies will also 'organise' permits

(8) Even I can see that free-of-cost requirements are economic madness
- maintaining secure payment infrastructure does cost money
- carefully built collections of personal data are very valuable

(9) In general, inherent tensions between PSD2 and GDPR
- problematic for banks; little guidance from regulators so far
- will lead to uncertainty and litigation

Where we are, so far

Final remarks

- Computer security & privacy are now essential for the financial sector
  - not only for protection of existing infrastructure
  - but also for new cryptocurrencies and services
- Blockchain is the hype of the century
  - too much bluff your way into blockchain
  - proper knowledge and critical attitude are badly needed
- PSD2 is an epic European shoot-in-the-foot

For more positive use of technology, see: privacybydesign.foundation