

# Reverse Vending Machine (RVM) Exploits

## Real world exploits / vulnerabilities

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ITSECX October  
7th 2022

J. Zivanovic  
M. Leithner  
D. E. Simos

Motivation

RVM  
Functionality

Past Attacks

Our Attack

Store Reaction

Other countries

Mitigation

Conclusion

- Motivation
- How do RVMs work?
- Past Attacks
- Our Attack
- Store Reaction
- Other countries
- Conclusion

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- **Financial Aspect:** Receipts traded for money (Free Money?)
- Austria plans to **extend it's RVM infrastructure** to accept plastic bottles and cans [1]

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- RVM Functionality
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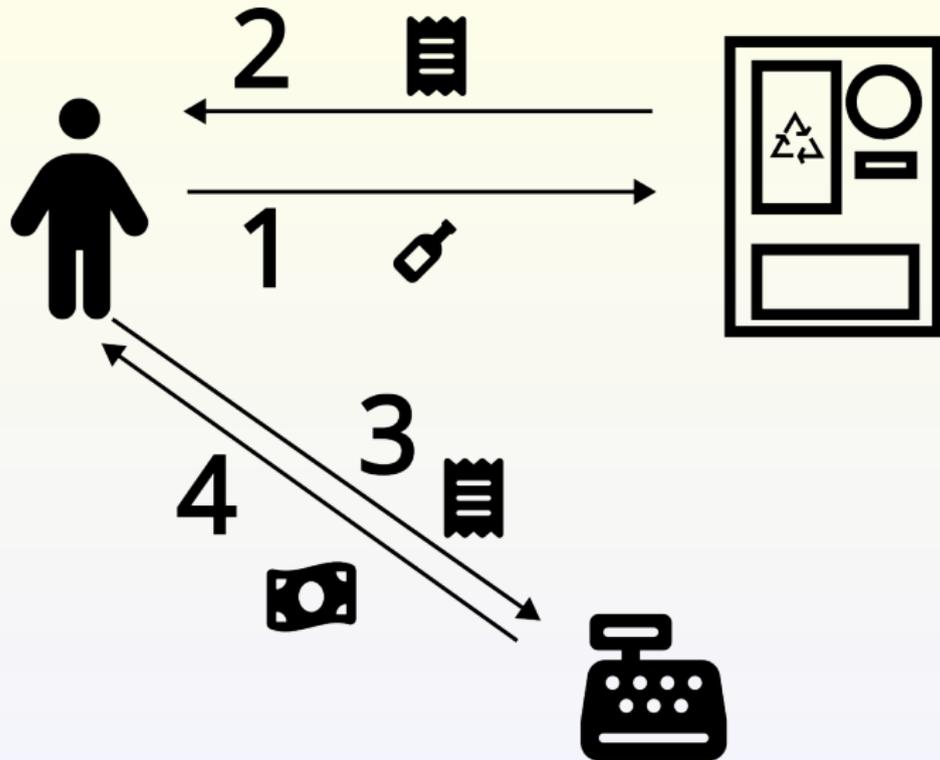


Figure: Visualization of reverse vending process.

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- Barcode Scanner
- Material Detection (IR spectrometer)
- Shape Detection (camera)
- Weight (weight sensor)
- Combination of multiple attributes

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365 > VERBRAUCHER NEWS

## Bei Aldi, Lidl, Rewe, Edeka und Co.: So dreist tricksen Betrüger an den Pfandautomaten

26.11.2021 06:12

KONSTANTINOS MITSIS



Köln

## Betrüger erbeutet 44.000 Euro mit einer Pfandflasche

Ein Getränkehändler bereicherte sich um Zehntausende Euro, indem er einen Pfandautomaten manipulierte. Das Amtsgericht Köln hat den Mann nun verurteilt. Sein Trick war recht simpel.

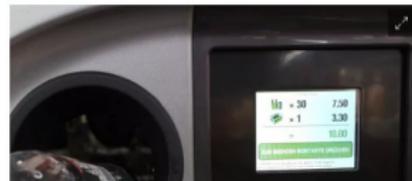
16.11.2016, 17:47 Uhr



Pfandbetrug

## Wie aus 25 Cent Millionen Euro werden

10. April 2019, 14:27 Uhr



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- Many different/creative methods (fishing line [4])
- Usually employee changes machine configuration or interferes with its processing pipeline
- Two men in Germany made 115 000€ by not shredding bottles and re-returning them [3]

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- Trivial if only barcode scanner used (Aldi Nord: Toilet paper rolls with barcode [4])
- Goal is to make the machine accept products that it would not usually deem valid
- Couple collected bottles from other country
- Bottles not accepted, but they placed barcodes of accepted bottles over original [4]

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- Not really realistic (except if only barcode scanner is used)
- Goal is to get a bottle recognized as something more valuable
- E.g. assume object detection is used to differentiate between bottles and crates
- An attack would be to get a bottle to be recognized as a crate, thus giving the attacker a higher deposit

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## What about receipts?

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Figure: Store I receipts for one returned bottle.



Figure: Store II receipts for returned bottles.

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Figure: Store III receipts for returned bottles.

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- Store II Receipts all look the same, independent of timestamp, receipt no., location.
- Store I & III Receipts also look very similar, however, barcode seems to be somewhat dynamic.
- Receipts contain receipt no., maybe value of receipt is checked when used?

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- Name of store (cut off)
- Address (cut off)
- Receipt Number (optional)
- Credit
- Barcode
- Timestamp

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- Barcode consists of 13 digits.
- Country Code (2 digits)
- Manufacturer Code (5 digits)
- Product Code (5 digits)
- Checksum (1 digit)

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- 'We know...'
- 'Who will exploit it?'
- 'Known issue, will switch in future'

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- **A Security Analysis of the Danish Deposit Return System**<sup>1</sup>
  - Found same results for Danish stores

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<sup>1</sup><https://itu.dk/people/rosg/paper/human.pdf>

- Almost every can/glass bottle/plastic bottle is recyclable
- Many RVMs in almost every supermarket
- Mostly same RVMs as in Vienna



Figure: Identical receipts for two separate bottle returns.

- However, bottles from other countries sometimes have a special barcode sticker
- Potentially marker for machine to detect 'unusual' bottles that should be recycled
- What happens when the sticker is missing?
- What happens when the sticker is on another bottle?



Figure: 'Aftermarket' recycling sticker.

- 'Special Bottle' without sticker  $\implies$  No money, but still accepted (right)
- Normal Bottle (10c) with special sticker  $\implies$  20c receipt (left)
- Can we take any bottle and simply slap a sticker on it and get money?



Figure: Receipts of the modified bottles.

- Use dynamically generated codes
- Save unused codes in online database
- Remove code from database upon usage

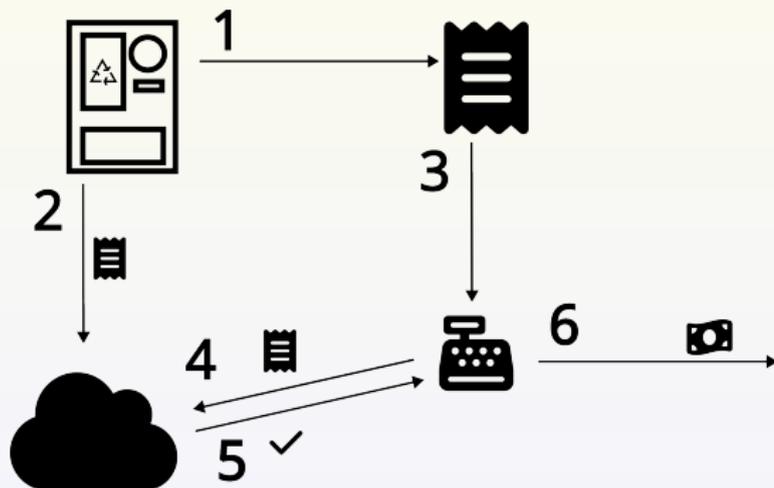


Figure: Possible mitigation against receipt forgery.

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- Just take the secure setup if you have the choice...
- Don't use receipts (wasted paper)

## Thank you for your Attention!



Questions? - Comments?



[1] Austrian News Article referencing returnable plastic bottles and cans.

*Oesterreich.orf.at, 13.10.21*

<https://oesterreich.orf.at/stories/3125584/>



[2] Sueddeutsche Zeitung, Pfandbetrug 3 Fälle

*sueddeutsche.de, 13.10.21*

<https://www.sueddeutsche.de/panorama/pfandbetrug-urteil-kriminalitaet-1.4403519>



[3] Spiegel.de, Pfandautomat Manipulation

*Spiegel.de, 13.10.21*

<https://www.spiegel.de/panorama/justiz/koeln-betrueger-erbeutet-mit-einer-pfandflasche-44-000.html>



[4] Chip.de, Pfandbetrug

*chip.de, 13.10.21*

<https://www.chip.de/news/Bei-Aldi-Lidl-Rewe-Edeka-und-Co.>

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-So-dreist-tricksen-Betrueger-an-den-Pfandautomaten\_  
116255908.html