

NEXT GENERATION INTERNET

The GNU Taler Payment System

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Agenda

Motivation & Background

GNU Taler: Introduction

Protocol Basics

Offline payments

Oral Information Management

Future Work & Conclusion

A Social Problem

This was a question posed to RAND researchers in 1971:

“Suppose you were an advisor to the head of the KGB. Suppose you are given the assignment of designing a system for the surveillance of all citizens and visitors within the boundaries of the USSR. The system is not to be too obtrusive or obvious. What would be your decision?”

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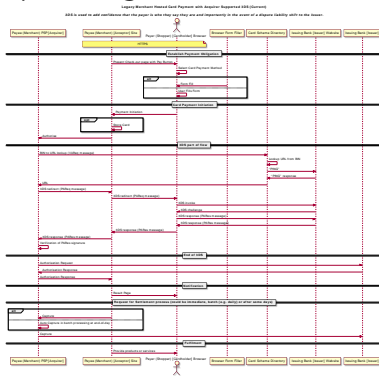
“I think one of the big things that we need to do, is we need to get away from true-name payments on the Internet. The credit card payment system is one of the worst things that happened for the user, in terms of being able to divorce their access from their identity.”

–Edward Snowden, IETF 93 (2015)

Banks have Problems, too!

3D secure (“verified by visa”) is a nightmare:

- ▶ Complicated process
- ▶ Shifts liability to consumer
- ▶ Significant latency
- ▶ Can refuse valid requests
- ▶ Legal vendors excluded
- ▶ No privacy for buyers



Online credit card payments will be replaced, but with what?

The Bank's Problem

- ▶ Global tech companies push oligopolies
- ▶ Privacy and federated finance are at risk
- ▶ Economic sovereignty is in danger



Predicting the Future

- ▶ Google and Apple will be your bank and run your payment system
- ▶ They can target advertising based on your purchase history, location and your ability to pay
- ▶ They will provide more usable, faster and broadly available payment solutions; our federated banking system will be history
- ▶ After they dominate the payment sector, they will start to charge fees befitting their oligopoly size
- ▶ Competitors and vendors not aligning with their corporate “values” will be excluded by policy and go bankrupt
- ▶ The imperium will have another major tool for its financial warfare

Central Bank Digital Currency?

Speech by Augustin Carstens, Bank of International Settlements (October 2020) on the difference between Central Bank Digital Currencies and cash.

Central Bank Digital Currency vs. Cash

https://www.youtube.com/watch?v=R_E4Uu7ycqE (10'2020)

GNU Taler: Introduction

GNU Taler [1, 3, 2]

Digital cash, made **socially responsible**.



Privacy-Preserving, Practical, Taxable, Free Software, Efficient

What is Taler?

<https://taler.net/en/features.html>

Taler is

- ▶ a Free/Libre software *payment system* infrastructure project
- ▶ ... with a surrounding software ecosystem
- ▶ ... and a company (Taler Systems S.A.) and community that wants to deploy it as widely as possible.

However, Taler is

- ▶ *not* a currency or speculative asset
- ▶ *not* a long-term store of value
- ▶ *not* a network or instance of a system
- ▶ *not* based on proof-of-work or proof-of-stake

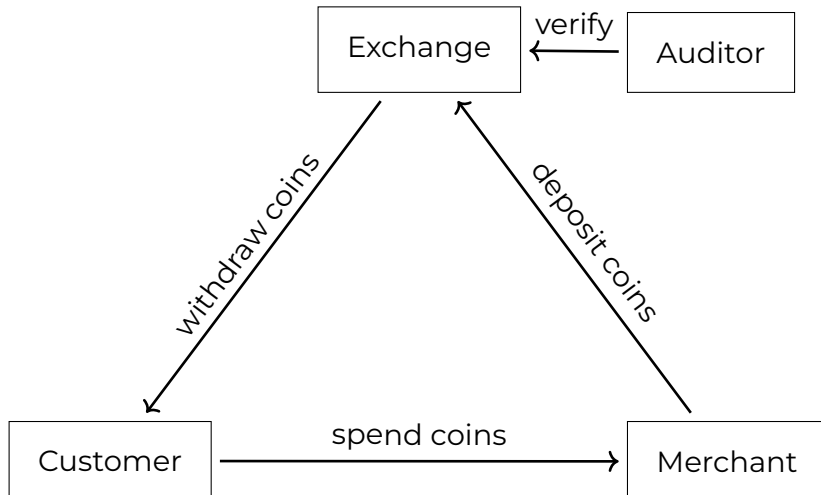
Design principles

<https://taler.net/en/principles.html>

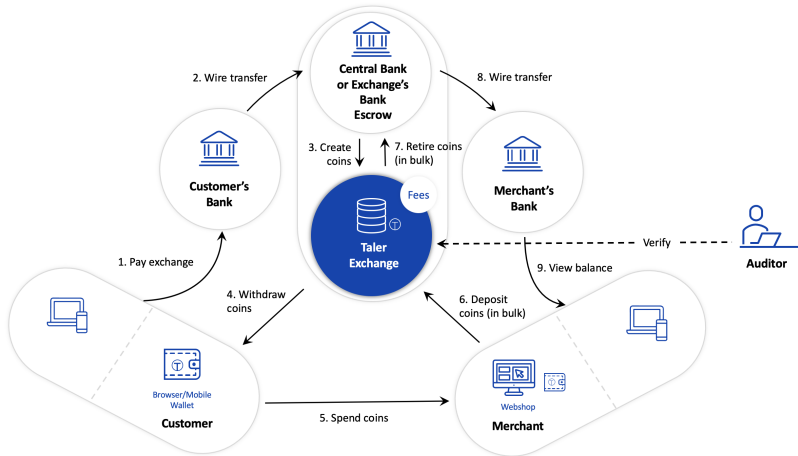
GNU Taler must ...

1. ... be implemented as **free software**.
2. ... protect the **privacy of buyers**.
3. ... enable the state to **tax income** and crack down on illegal business activities.
4. ... prevent payment fraud.
5. ... only **disclose the minimal amount of information necessary**.
6. ... be usable.
7. ... be efficient.
8. ... avoid single points of failure.
9. ... foster **competition**.

Taler Overview



Architecture of Taler



Consumer Impact of Taler

- ▶ **Convenient:** pay with one click instantly — in Euro, Dollar, Yen or Bitcoin
- ▶ **Friction-free security:** Payments do not require sign-up, login or multi-factor authentication
- ▶ **Privacy-preserving:** payment requires/shares no personal information
- ▶ **Bank account:** not required

Merchant Impact of Taler

- ▶ **Instant clearance:** one-click transactions and instant clearance at par
- ▶ **Easy & compliant:** GDPR & PCI-DSS compliance-free and without any effort
- ▶ **Major profit increase:** efficient protocol + no fraud = extremely low costs
- ▶ **1-click checkout:** without Amazon and without false positives in fraud detection

Usability of Taler

`https://demo.taler.net/`

1. Install browser extension.
2. Visit the `bank.demo.taler.net` to withdraw coins.
3. Visit the `shop.demo.taler.net` to spend coins.

Protocol Basics

How does it work?

We use a few ancient constructions:

- ▶ Cryptographic hash function (1989)
- ▶ Blind signature (1983)
- ▶ Schnorr signature (1989)
- ▶ Diffie-Hellman key exchange (1976) or Unique signatures (1977) or VRF (1999)
- ▶ Cut-and-choose zero-knowledge proof (1985)

But of course we use modern instantiations.

Definition: Taxability

We say Taler is taxable because:

- ▶ Merchant's income is visible from deposits.
- ▶ Hash of contract is part of deposit data.
- ▶ State can trace income and enforce taxation.

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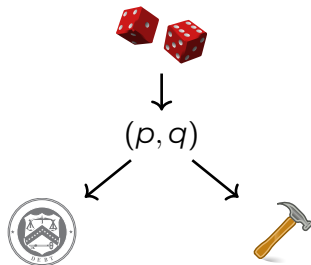
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Limitations:

- ▶ withdraw loophole
- ▶ *sharing* coins among family and friends

Exchange setup: Create a denomination key (RSA)

1. Generate random primes p, q .
2. Compute $n := pq$,
 $\phi(n) = (p - 1)(q - 1)$
3. Pick small $e < \phi(n)$ such that $d := e^{-1} \bmod \phi(n)$ exists.
4. Publish public key (e, n) .



Merchant: Create a signing key (EdDSA)

- ▶ Generate random number $m \bmod o$ as private key
- ▶ Compute public key $M := mG$



↓
 m

↓
 M

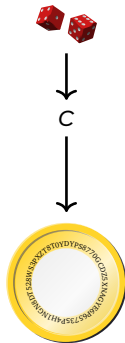
Capability:

$m \Rightarrow$



Customer: Create a planchet (EdDSA)

- ▶ Generate random number $c \bmod o$ as private key
- ▶ Compute public key $C := cG$

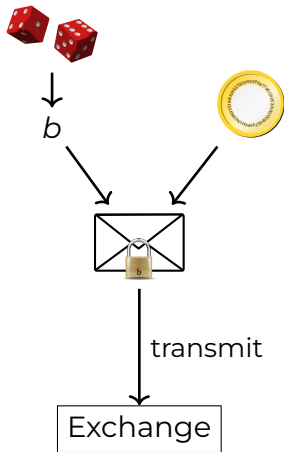


Capability: $c \Rightarrow$



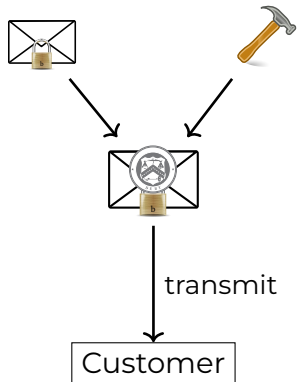
Customer: Blind planchet (RSA)

1. Obtain public key (e, n)
2. Compute $f := \text{FDH}(C)$,
 $f < n$.
3. Generate random blinding factor $b \in \mathbb{Z}_n$
4. Transmit $f' := fb^e \pmod n$



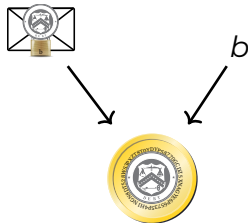
Exchange: Blind sign (RSA)

1. Receive f' .
2. Compute $s' := f'^d \bmod n$.
3. Send signature s' .

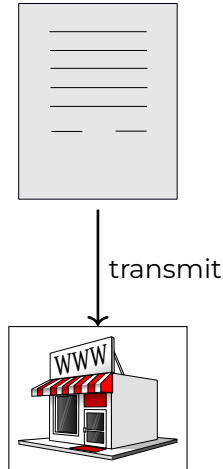


Customer: Unblind coin (RSA)

1. Receive s' .
2. Compute $s := s'b^{-1} \bmod n$

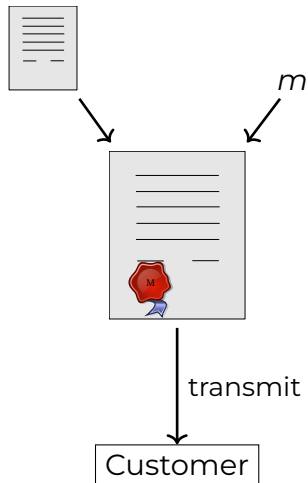


Customer: Build shopping cart



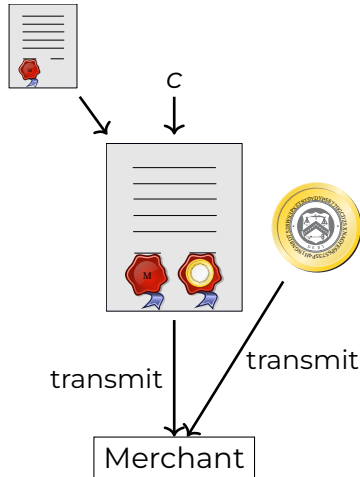
Merchant: Propose contract (EdDSA)

1. Complete proposal D .
2. Send $D, \text{EdDSA}_m(D)$



Customer: Spend coin (EdDSA)

1. Receive proposal D , $EdDSA_m(D)$.
2. Send s , C , $EdDSA_c(D)$



Merchant and Exchange: Verify coin (RSA)

$$s^e \stackrel{?}{\equiv} FDH(C) \pmod{n}$$



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Taler is an online payment system.

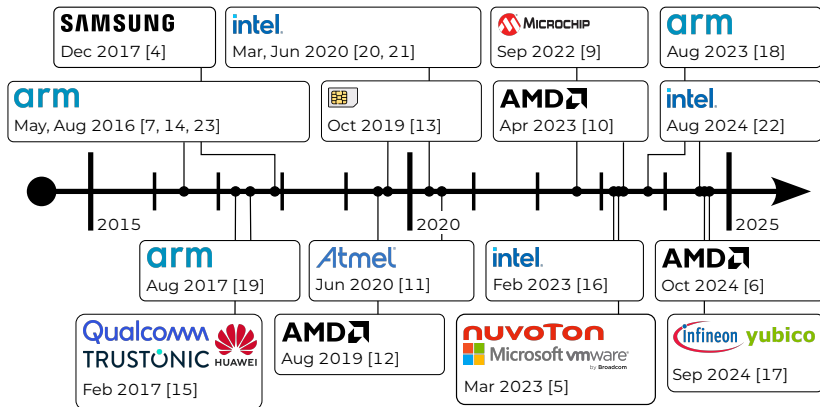
Offline payments

Digitaler Euro — Offline?

Many central banks today demand offline capabilities for CBDCs.

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A Scenario

God is offline, but customer pays online

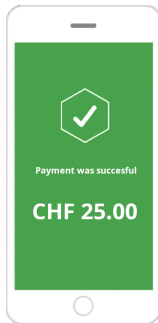


Typical Payment Process

All equivalent: Twint, PayPal, AliPay, PayTM

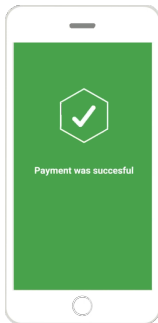
Secure Payment ...

Everything green?



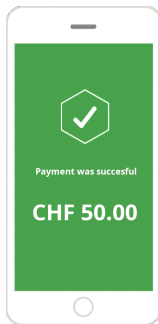
Exploit “Code”

Programming optional

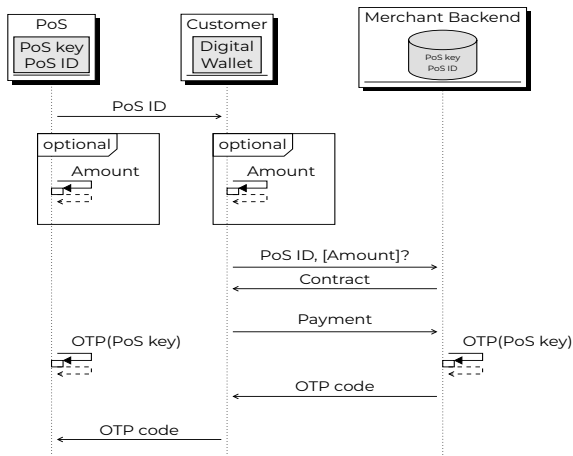


“Customers” love Twint ...

Daily non-business for shops



Partially Offline Payments with GNU Taler [8]



Oral Information Management

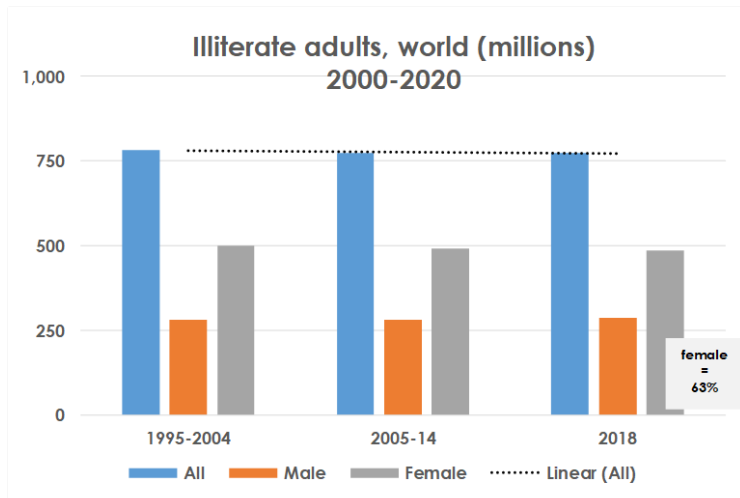
joint work with
MyOralVillage

Oral Information Management (OIM)

OIM is a human-centered design practice governed by the following principles:

1. Designs must first enhance client-side financial product usability.
2. Designs should provide positive incentives to clients to acquire useful financial numeracy and financial literacy skills.
3. The design process is client-guided.
4. Oral designs should not embarrass or inconvenience or literate clients.

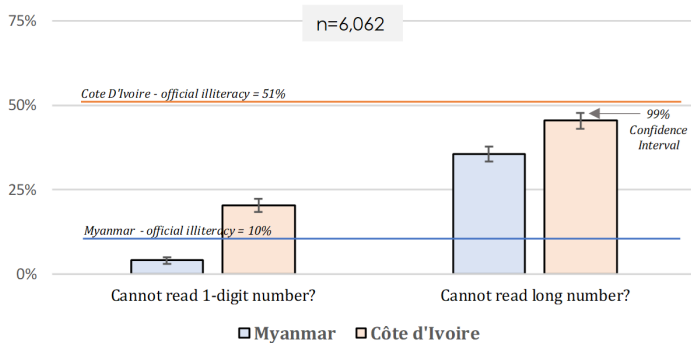
Literacy



Numeracy

Error Rate

Financial Inclusion Insights Wave 5 (2017)



Design



Results from Freetown (2025)

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- ▶ Four (4) completed all 8 tasks with two tries but no help. Only one was unable to complete the process successfully.

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- ▶ “This app is much better than Afrimoney. Everyone would use it.”
- ▶ “It’s simple, and you can correct your mistakes.”
- ▶ After the test, participants were asked if they would use OIM Taler, if it were available in Sierra Leone? All (!) stated that they:
 - ▶ would like to use it,
 - ▶ prefer it to existing apps, and
 - ▶ would share it with their friends and relations, especially those who had trouble with writing and numbers.

The Emergency Act of Canada

Speech by Premier Kenney, Alberta, February 2022.

The Emergency Act of Canada

<https://www.youtube.com/watch?v=NehMAj492SA> (2'2022)

Future Work & Conclusion

Use Case: Journalism

Today:

- ▶ Corporate structure
- ▶ Advertising primary revenue
- ▶ Tracking readers critical for business success
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With GNU Taler:

- ▶ One-click micropayments per article
- ▶ Hosting requires no expertise
- ▶ Reader-funded reporting separated from marketing
- ▶ Readers can remain anonymous

Taler: Project Status

<https://docs.taler.net/>

- ▶ Cryptographic protocols and core exchange component are stable
- ▶ Pilot project at Bern University of Applied Sciences cafeteria
- ▶ Netzbond (regional currency) in Basel launched
- ▶ Taler Operations AG live Swiss-wide
- ▶ Internal alpha deployment with GLS Bank (Germany)
- ▶ Internal alpha deployment with Magnet Bank (Hungary)

Competitor comparison

	Cash	Bitcoin	Zero coin	Creditcard	GNU Taler
Online	----	++	++	+	+++
Offline	+++	--	--	+	++
Trans. cost	+	----	----	-	++
Speed	+	----	----	o	++
Taxation	-	--	----	+++	+++
Payer-anon	++	o	++	----	+++
Payee-anon	++	o	++	----	----
Security	-	o	o	--	++
Conversion	+++	----	----	+++	+++
Libre	-	+++	+++	- - -	+++

Other ongoing developments

- ▶ Privacy-preserving auctions (trading, currency exchange)
(oezguer@taler.net)
- ▶ Hardware and software support for embedded systems
(mikolai@taler.net)
- ▶ Tax-deductable receipts for donations to charities (donau.git)
- ▶ Unlinkable anonymous subscriptions and discount tokens
(ivan@taler.net)
- ▶ ...

Open Challenges

- ▶ Try to explain this to lawyers and AML staff of banks
- ▶ What are convincing arguments for citizens to switch?
- ▶ How to address anti-competitive cash-back from card payments?
- ▶ ...

How to support?

Join: <https://lists.gnu.org/mailman/listinfo/taler>

Discuss: <https://ich.taler.net/>

Develop: <https://bugs.taler.net/>, <https://git.taler.net/>

Apply: <https://nlnet.nl/propose>, <https://nlnet.nl/taler>

Translate: <https://weblate.taler.net/>, translation-volunteer@taler.net

Integrate: <https://docs.taler.net/>

Donate: <https://gnunet.org/ev>

Partner: <https://taler-systems.com/>

Conclusion


What can we do?

- ▶ Suffer mass-surveillance enabled by credit card oligopolies with high fees, and
- ▶ Engage in arms race with deliberately unregulatable blockchains



OR

- ▶ Establish free software alternative balancing social goals!


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Research and Innovation SERI**

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