Solving Fair Exchange with Mobile Agents

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Mobile agents and fair exchange

- Autonomous agents roam the web and perform electronic business transactions on behalf of the user.
- Items (goods, payment) must be exchanged in a fair manner.
- Fair exchange problem = how to exchange items between two parties without either party suffering a disadvantage.
- Our contribution: three increasingly flexible solutions to the problem using mobile agents.

What's the problem with fair exchange?

- An "unfair" exchange protocol:
  1. Agent enters vendor's host.
  2. Agent receives audio file.
  3. Agent pays electronically.
  4. Agent leaves host.

audio file
electronic money

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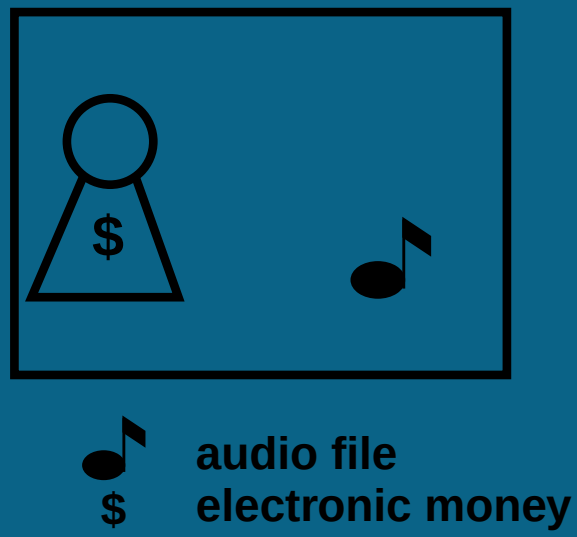

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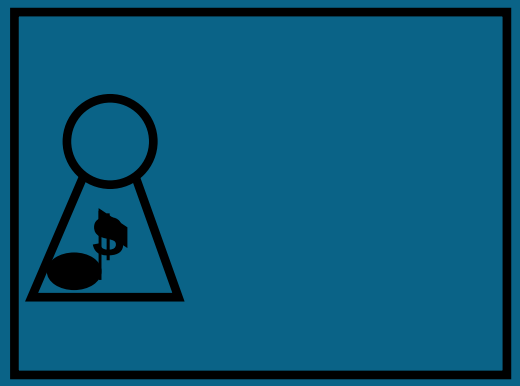

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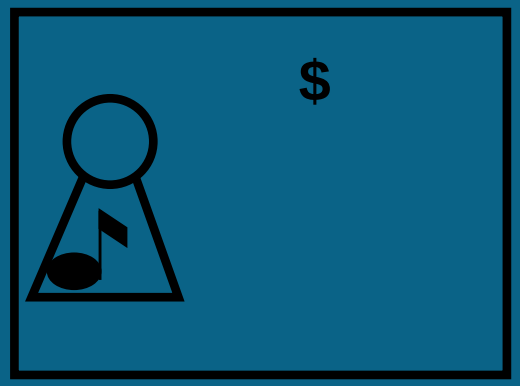

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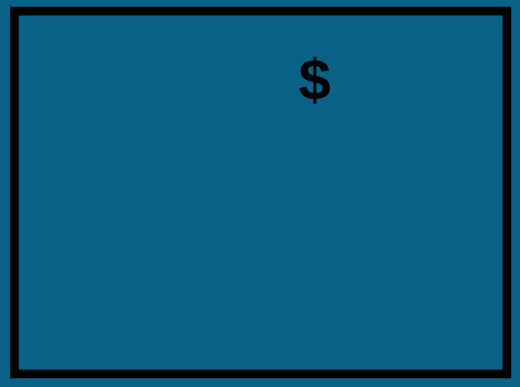

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- Visiting agent can run without paying (after step 2).
- Vendor can kidnap agent (after step 3).

Solution 1: locked room

- Locked room protocol:
  1. Agents enter.
  2. Doors close, agents swap.
  3. Agents check and commit.
  4. Doors open, agents leave.

- Ensure that no information leaves the room!

- Ensure that agents are destroyed if one does not commit!

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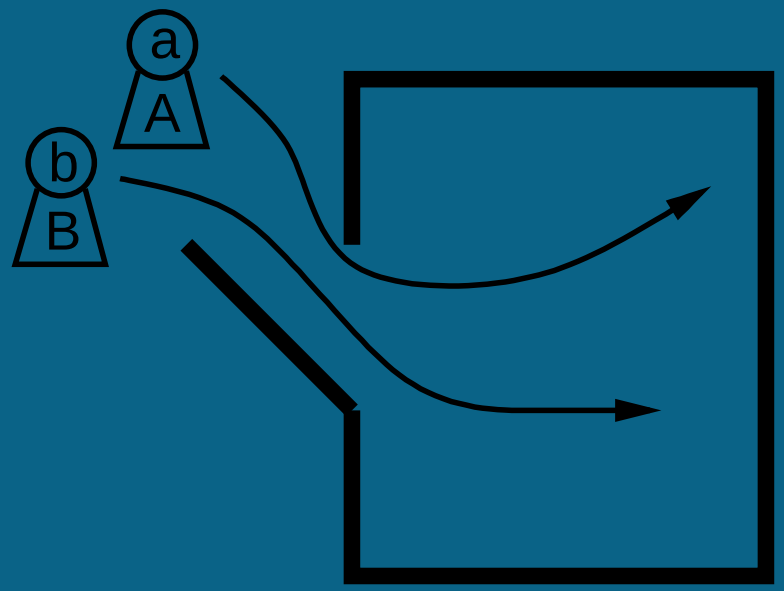

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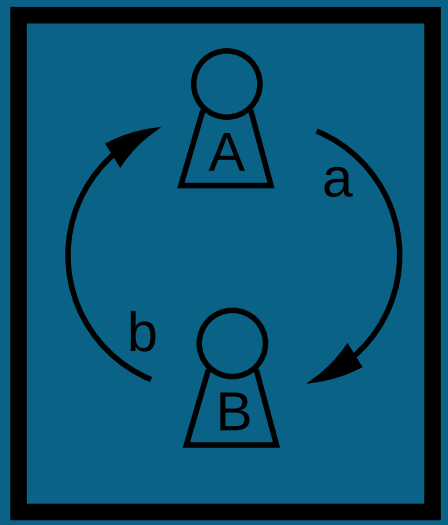

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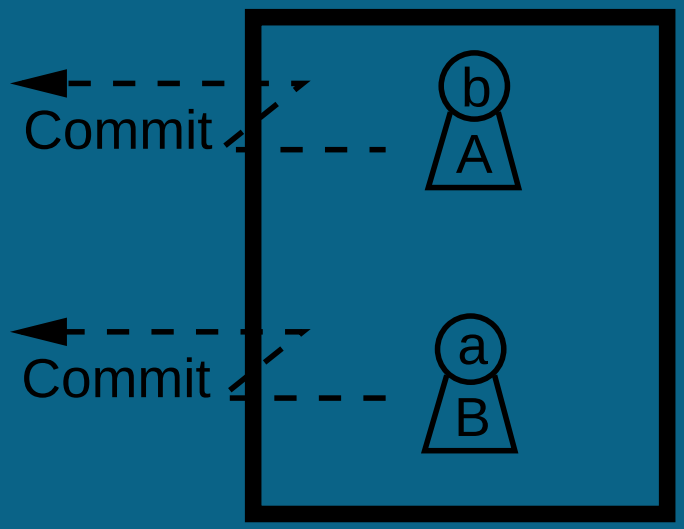

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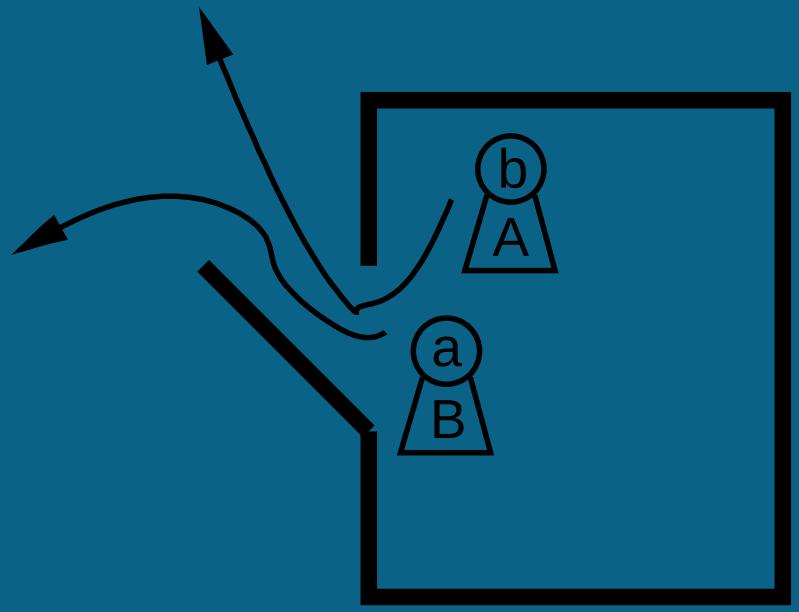

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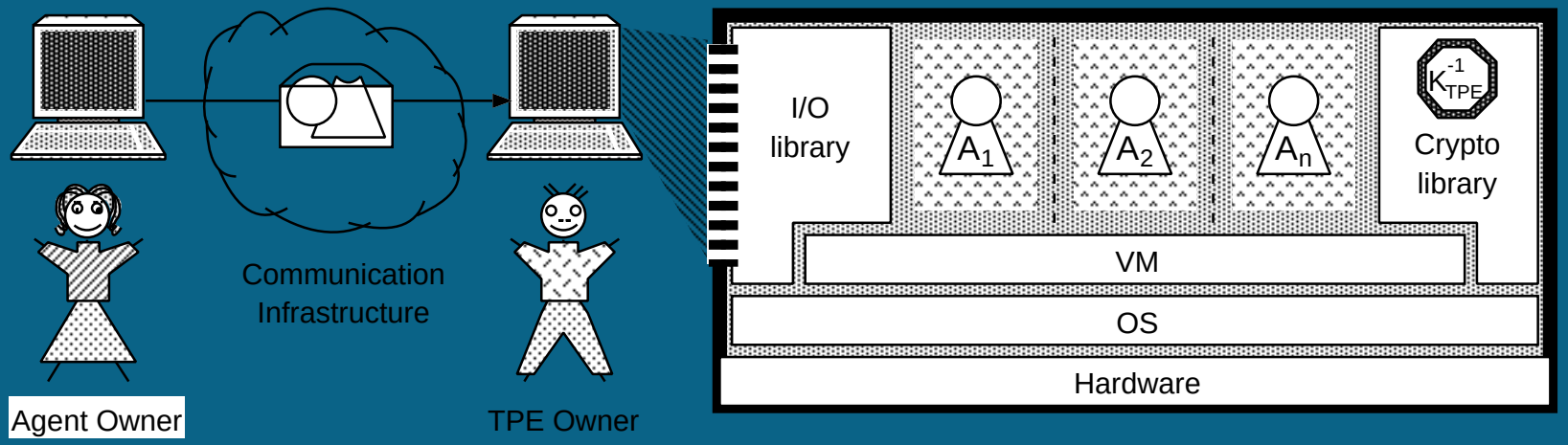
Trusted Processing Environment (TPE)

- Provides secure execution environment on tamper proof hardware device.



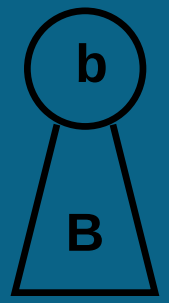
- Protect agents from host and agents from agents.
- Must be fully certified.

Implementation of solution 1

- Protection guarantees formalized as *policies* associated with underlying hardware.
- Implement new *fair exchange policy* based on the following operations:
  - ⋆ `BeginFairExchange(AgentId id)`
  - ⋆ `CommitFairExchange()`
  - ⋆ `AbortFairExchange()`
- TPE restricts communication during exchange and destroys both agents if one doesn't commit.

Solutions 2 & 3: use fair exchange agent

- Use an intermediate *fair exchange agent* (FEA) to validate and swap items.
- FEA performs exchange only if items are as expected.



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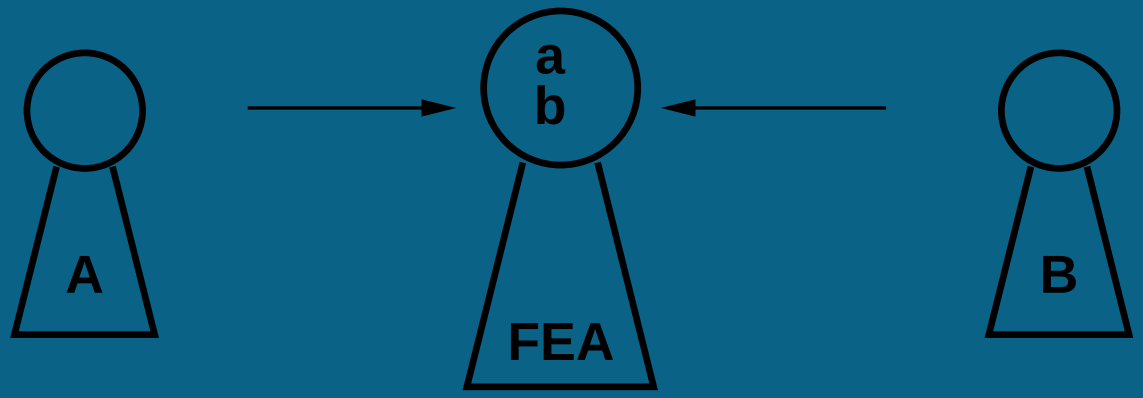

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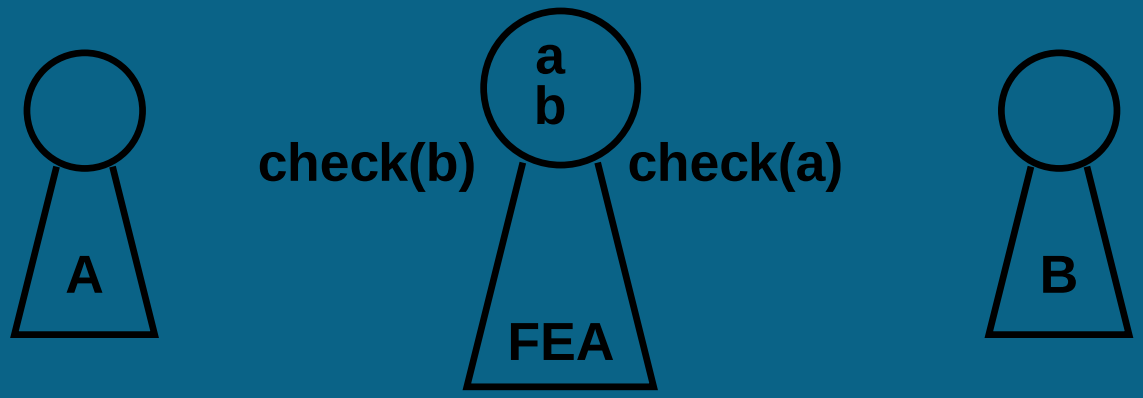

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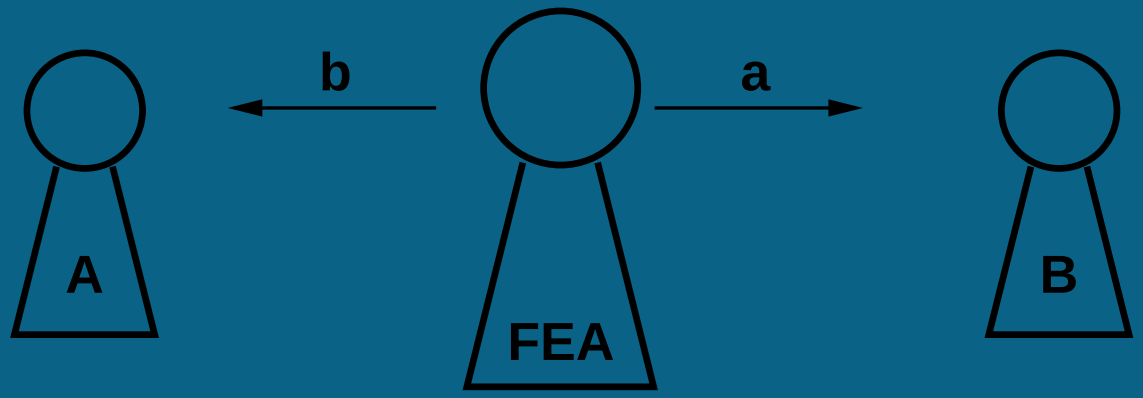

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The check routine problem

- Validation must be done inside FEA.
- Agents devise specific `check` method.
- Must ensure that no information leaks out of `check` method = check routine problem.
- Possible solutions:
  - ⋆ Parametrized `check` routines.
  - ⋆ Sandboxing.
  - ⋆ . . .

Solution 2

- Let agents check the `check` routines and agree on a mutually checked FEA.
- Agents trust FEA because executed code is ensured to be authentic.
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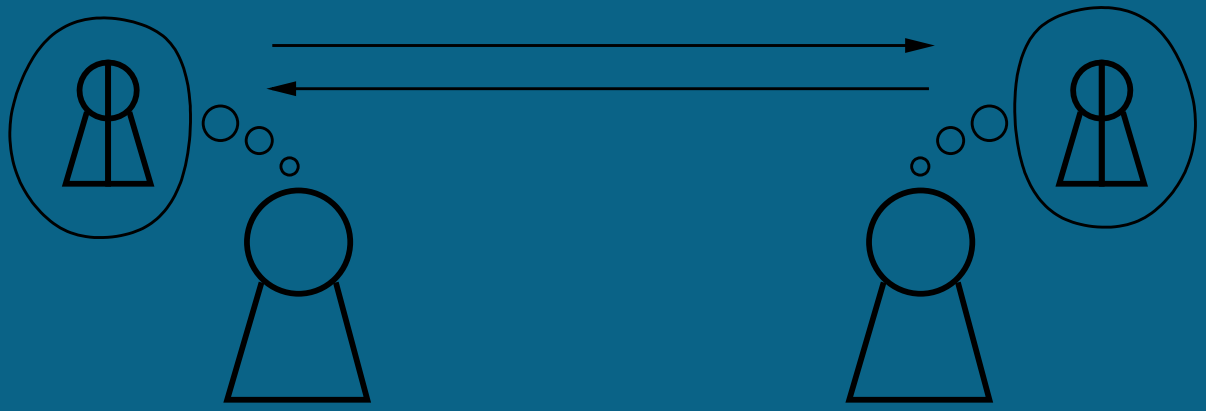

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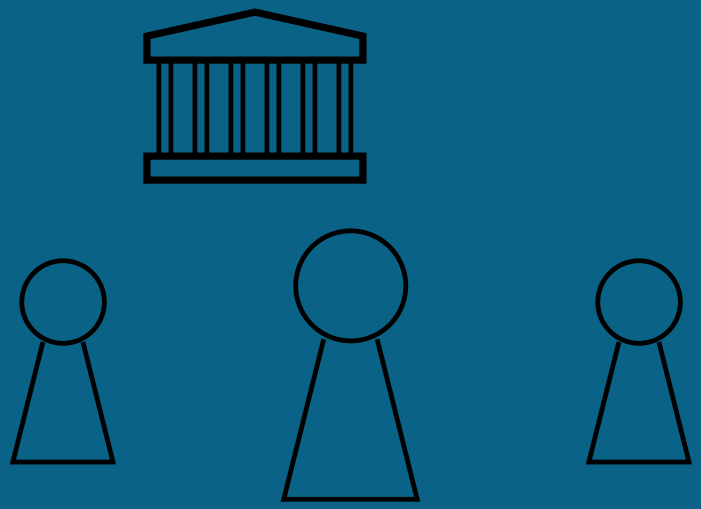
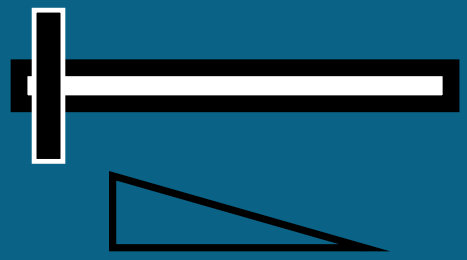


Solution summary and overview

	Solution	Fairness ensured by	Requirements on TPE
1.	Locked room	TPE	Specific fair exchange operations
2.	Authentic code	FEA code checking	generic authentic code
3.	Free-lance FEA	FEA provider	basic protection



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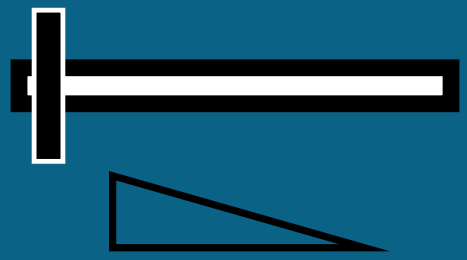

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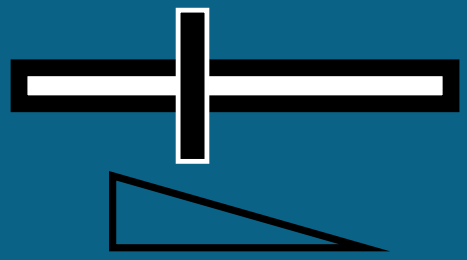

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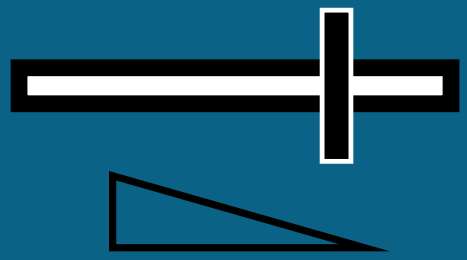

Advanced questions and future work

- TPE ist still rather “fictional”: IBM 4758 PCI useable?
- Adaption of protocols using other means to ensure security possible, e.g. Smartcards (prior talk by Günter Karjoth)?
- In Solutions 2 & 3 the FEA plays the role of a “trusted third party” (TTP). What constitutes a TTP and where is the TTP in solution 1?

Acknowledgements

- Slides produced using "cutting edge" LaTeX slide processor PPower4 by Klaus Guntermann.