NGI TRUST CHAIN

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BILANCIO CO2 ZERO

Zero Bridge: Make Permissioned Blockchains Interoperable

AGILE BY CHAIN

Ph.D. Candidate Alessandro Bigiotti, Prof. Leonardo Mostarda, Prof. Alfredo Navarra, Prof. Andrea Pinna, Prof. Roberto Tonelli

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A.D. 1308 unipg
UNIVERSITÀ DEGLI STUDI DI PERUGIA

UNICAM
Università di Camerino
1336

Università di Camerino

Zero Bridge Objectives

Project motivations:

- **Gap in literature**: In the literature we have found a lack of interoperability protocols between private and permissioned blockchains.
- **Practical needs**: Blockchain adoption in enterprise contexts can benefit from efficient and privacy-friendly interoperability protocols.

Project proposal:

ZeroBridge: *Designing and implementing a permissioned blockchain **interoperability protocol** that is inherently **secure**, highly **efficient**, broadly **applicable**, and **privacy-preserving** by design.*

Challenges: Access Control & Privacy

In interoperability protocols between private and permissioned blockchains, special attention must be paid to access control mechanisms and privacy that:

- Ensure inability of off-chain processes to **access writing to communicating blockchains**;
- Avoid **disclosing confidential information** to third parties;
- Allow **access only** to the portion of **data** that is the **subject of interchain transactions**;
- Allow the exchange of information **without resorting** to complex cryptographic primitives such as **Zero Knowledge Proof**.

Challenges: Efficiency & Security

Private and permissioned blockchains can have shorter block production times than public ones and transaction costs can be lowered to zero. The off-chain component for managing interchain transactions must be efficient, secure and have little or no cost:

- Design off-chain processes that are decentralised, are not connected with each other, and **avoid consensus algorithms**;
- Keep interchain transaction **costs constant or low**;
- Allow an interchain transaction to be finalised **using only two transactions** (one on the source blockchain and one on the destination blockchain).
- Implement **off-chain & on-chain verification** mechanisms for validating inter-chain transactions;

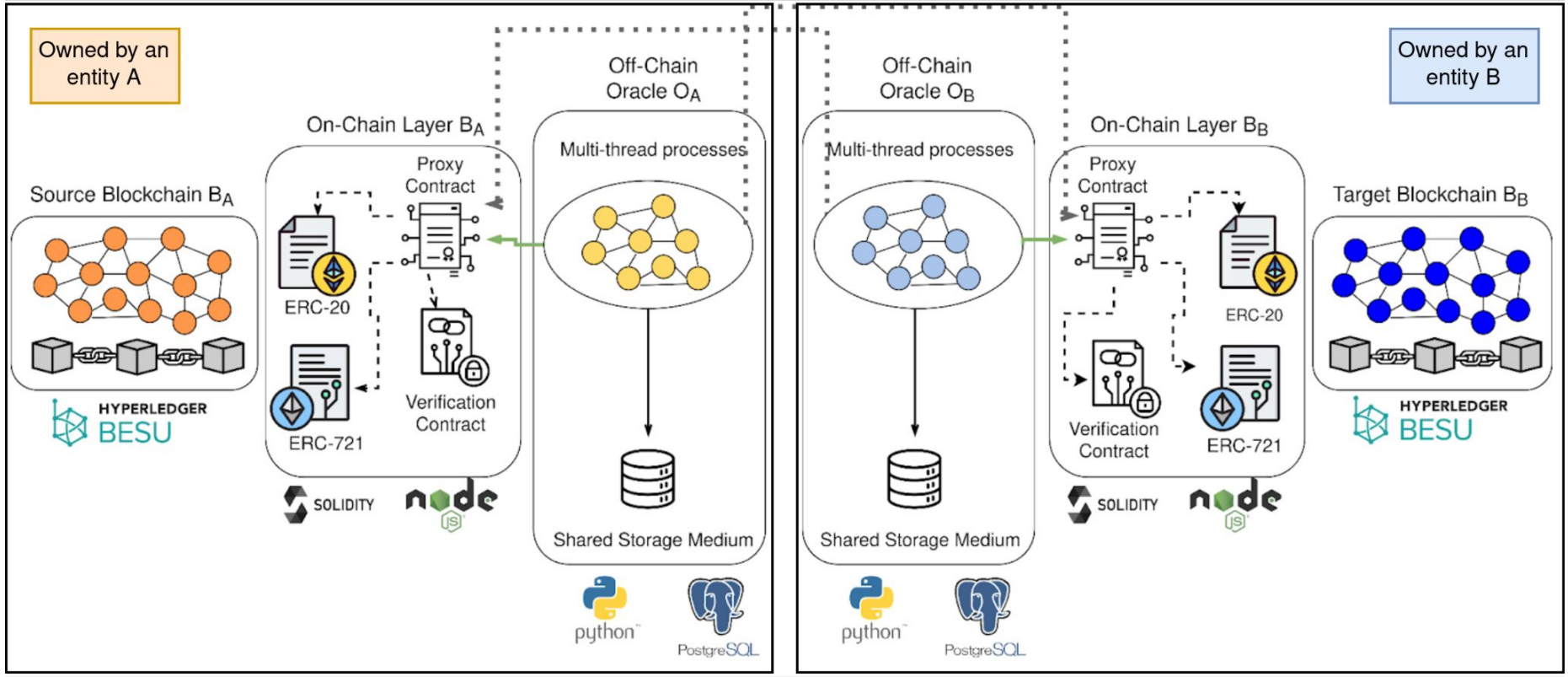
Challenges: General Purpose

In business contexts, blockchains can be used to implement logic and maintain data of different and arbitrary nature. In particular, in an interoperability scenario they:

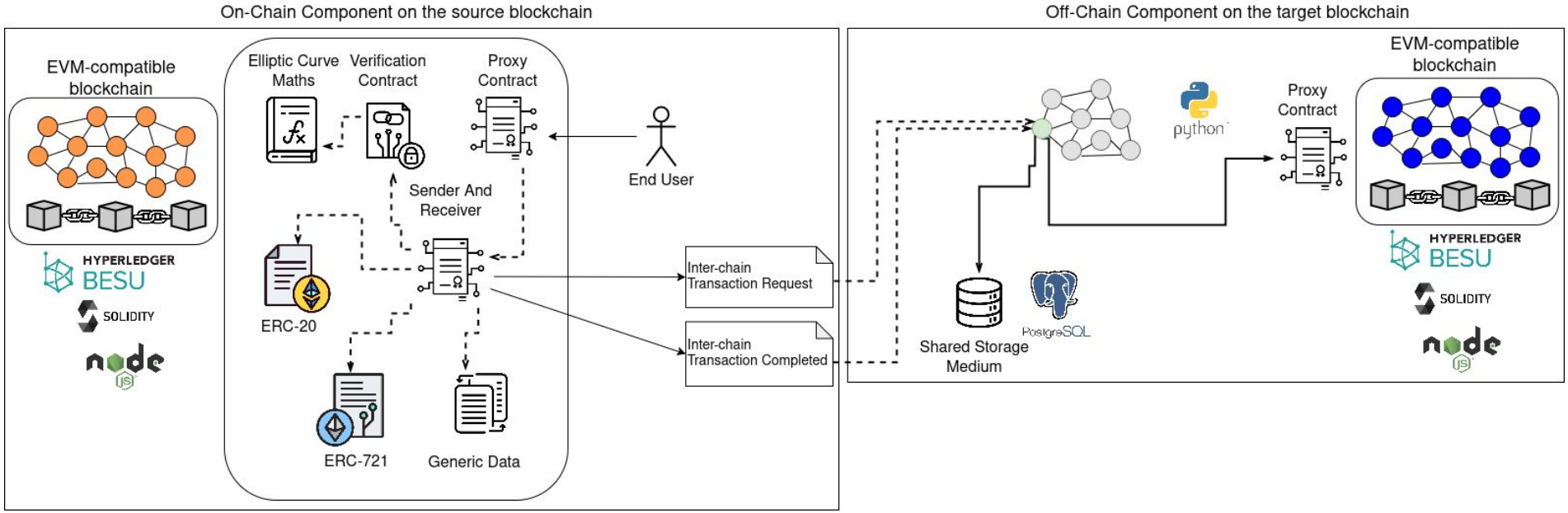
- **Abstract** from the **blockchain architecture** (cryptographic primitives, consensus algorithms, smart contract languages, etc...);

- Allow for **numerous use cases** such as: token transfer, data copying or synchronisation, or arbitrary invocation of smart contracts residing on different blockchains;

Overall Architecture



On-Chain and Off-Chain Components



Event Semantic

The events that drive off-chain processes contain JSON-formatted messages that enable a variety of use cases:

```
"header": {
        "source_chain": <chain id>,
        "timestamp": <current timestamp>,
        "sender": <address from source chain>
    },
```

```
"body": {
        "instructions": {
            "service": <service name>,
            "function": <function name>
            “roll_back”: <bool [True, False]>
        },
        "content": {
            "key_1": value_1,
                ...     ...
            "key_n": value_n,
        }
    }
```

Scalability and Security

Using a threshold signature in interchain transactions allows for more scalable off-chain processes and verifying signatures on-chain reduces the possibility of validating fraudulent transactions:

- The off-chain component implements a **distributed key generation algorithm** following Pedersen's Commitments, Verifiable Secret Sharing (VSS) and Feldman's commitments for an **ECDSA-based threshold signature**.

- The signature generation follows the **Schnorr scheme** (FROST 2020), with the difference that the proposed approach is a fully on-line leader-based two-round variant.

- The **signature (*R, s*) is verified on-chain** on a dedicated smart contract implementing a highly optimised library written in YUL and assembly.

Supported Standards

The proposed solution supports and requires compatibility with the following standards:

- **ERC-20, ERC-721, ERC-1151.** The protocol supports well-known standards for token representation.
- **ERC-1822, ERC-1967.** The protocol implements the Universal Upgradeable Proxy Standard;
- **ERC-173.** The protocol implements the Contract Ownership Standard;
- **ERC-2771.** Depending on the use case, the protocol requires compatibility with Secure Protocol for Native Meta Transactions.

References

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alessandro.bigiotti[at]unicam.it

https://www.linkedin.com/in/alessandro-bigiotti

https://www.researchgate.net/profile/Alessandro-Bigiotti-3