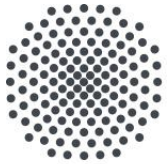
Modeling and Execution of Blockchain-aware Business Processes



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Institute of Architecture of Application Systems

Agenda

- Motivation
- Challenge: Durability (finality) of Blockchain Transactions
- Modeling and Execution of Blockchain-aware Business Processes
  - Blockchain-access Layer
  - Blockchain-aware BPMN Extension
  - System Architecture
- Conclusion

Motivation

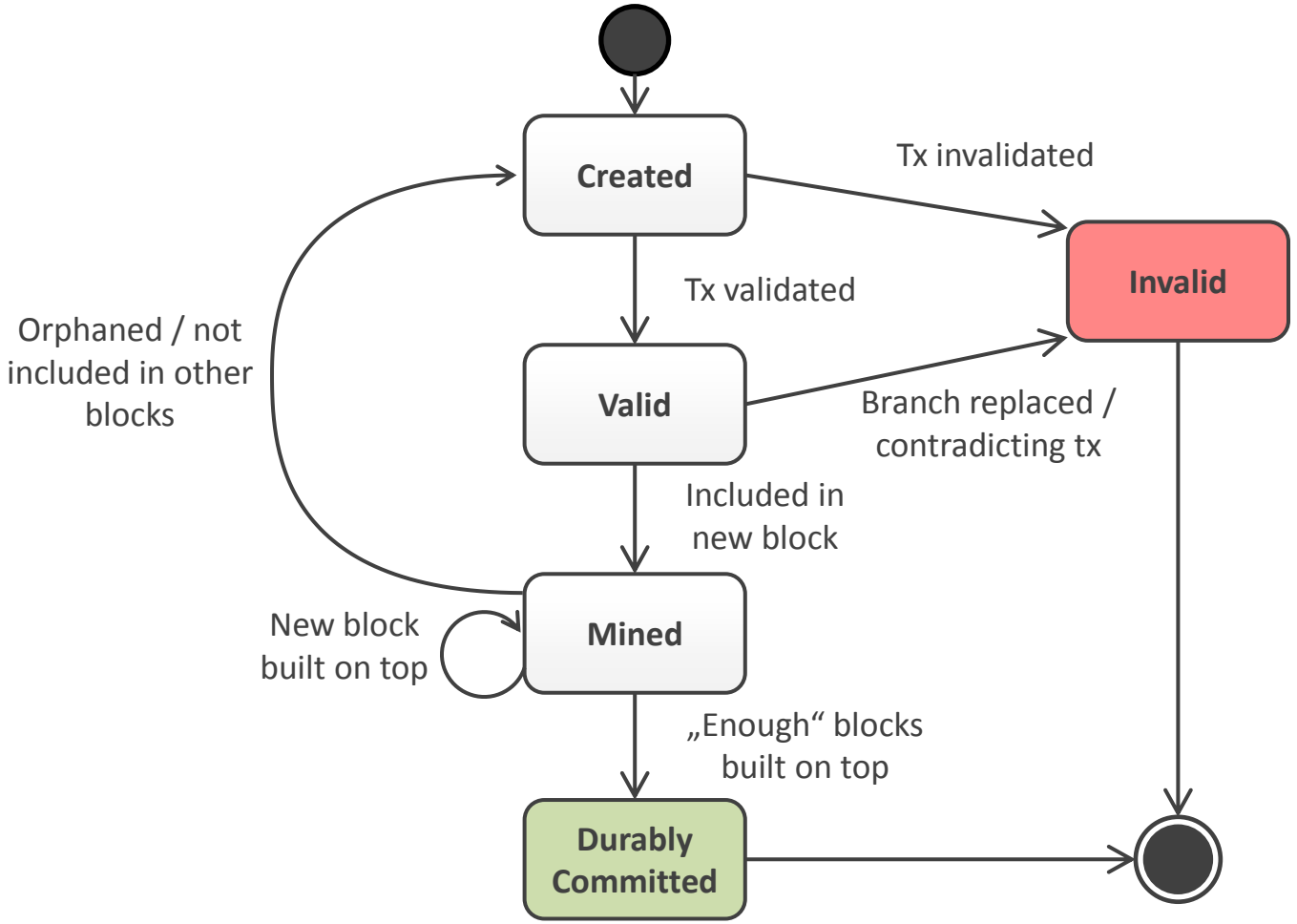
- Blockchains open new business opportunities (supply-chains, health-care, finance, etc.)
- Business partners already have automated business processes (BPMN, BPEL).
- Idea:
  - Allow existing business processes to communicate with blockchain-based systems.

Challenge: Durability (finality) of Blockchain Transactions

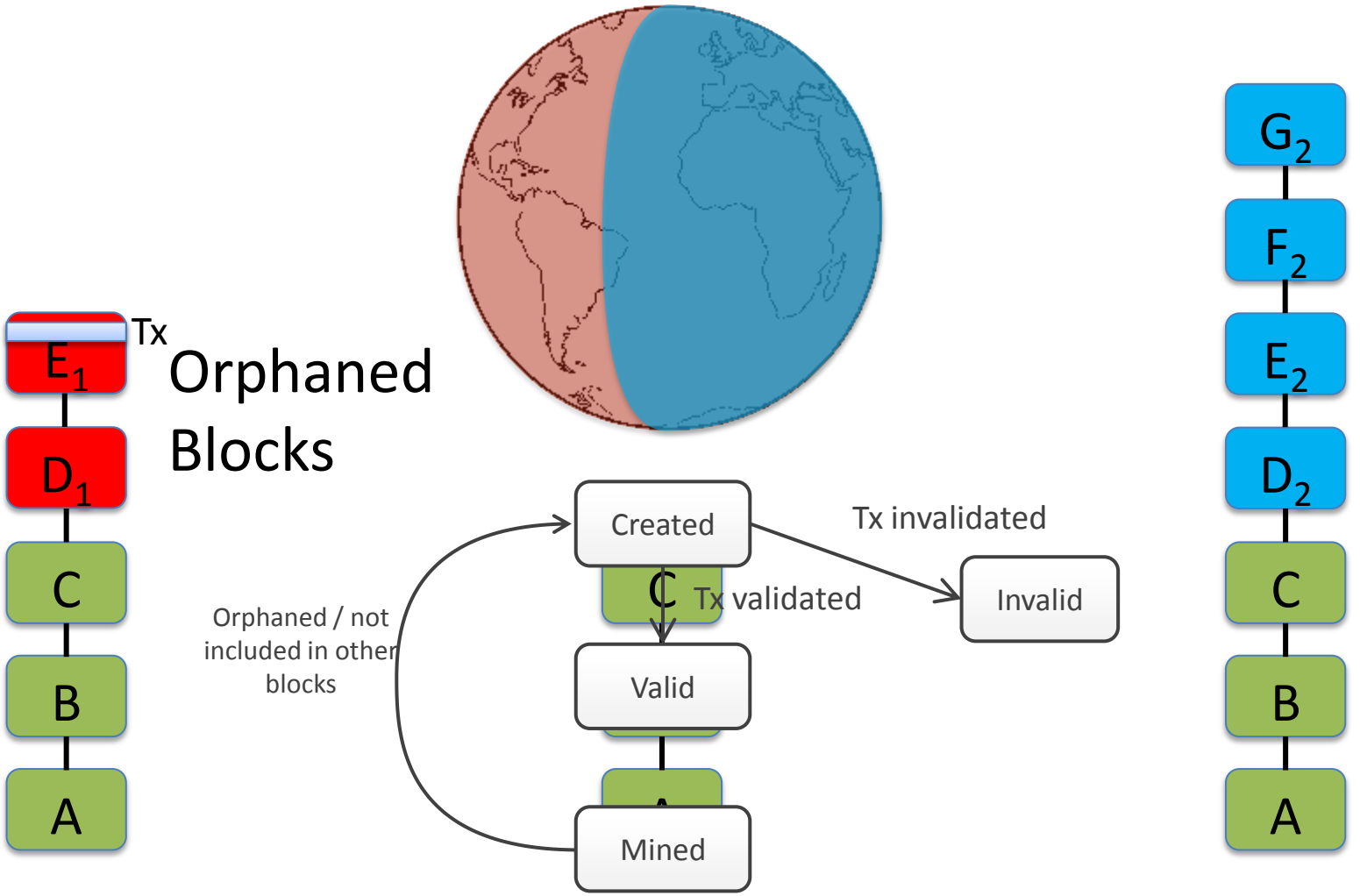
- Blockchains store some kind of a **state**:
  - The set of balances of all accounts (e.g., Bitcoin)
  - Smart contracts and their local storage (e.g., Ethereum)
- A **blockchain transaction** is an atomic change of the state.
  - Transfer of value from one account to another.
  - Execution of a smart contract that changes its local storage.
- Blockchain transactions have **inherent properties** that make using them by regular applications **challenging**.
  - We focus here on transaction **durability**.

Challenge: Durability (finality) of Blockchain Transactions

- A simplified lifecycle of a blockchain transaction (from the durability point-of-view):



Challenge: Durability (finality) of Blockchain Transactions



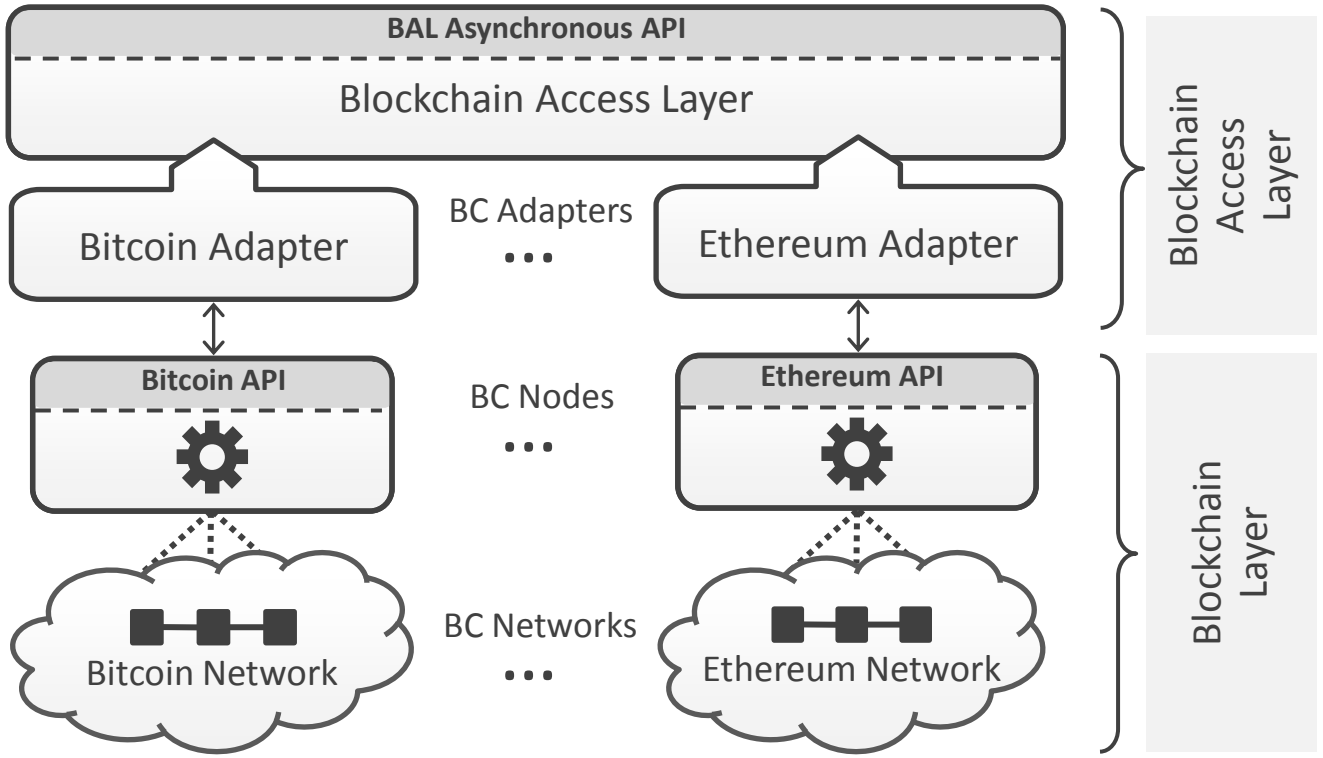
Handling Uncertainty of Transaction Durability

- **At the execution level:**
  - By creating an abstraction layer that provides access to blockchains and allows tackling their uncertainty - **Blockchain Access Layer (BAL)*.**
- **At the modeling level:**
  - By providing a **modeling extension** to BPMN 2.0 that supports communicating with the BAL and
  - by providing a set of rules to transform the extension artifacts to **standard-compliant BPMN 2.0** fragments.

*Open-source implementation available at: https://github.com/ghareeb-falazi/BlockchainAccessLayer

Blockchain-access Layer – Architecture

- An **extensible**, **technology-agnostic unification layer** that allows external applications to communicate with blockchains, while explicitly handling **transaction uncertainty** through an **asynchronous API**.



Blockchain-access Layer – API

- Operations accept a parameter called **“block-confirmations”** that allows specifying the **certainty level** that a transaction is durably committed.

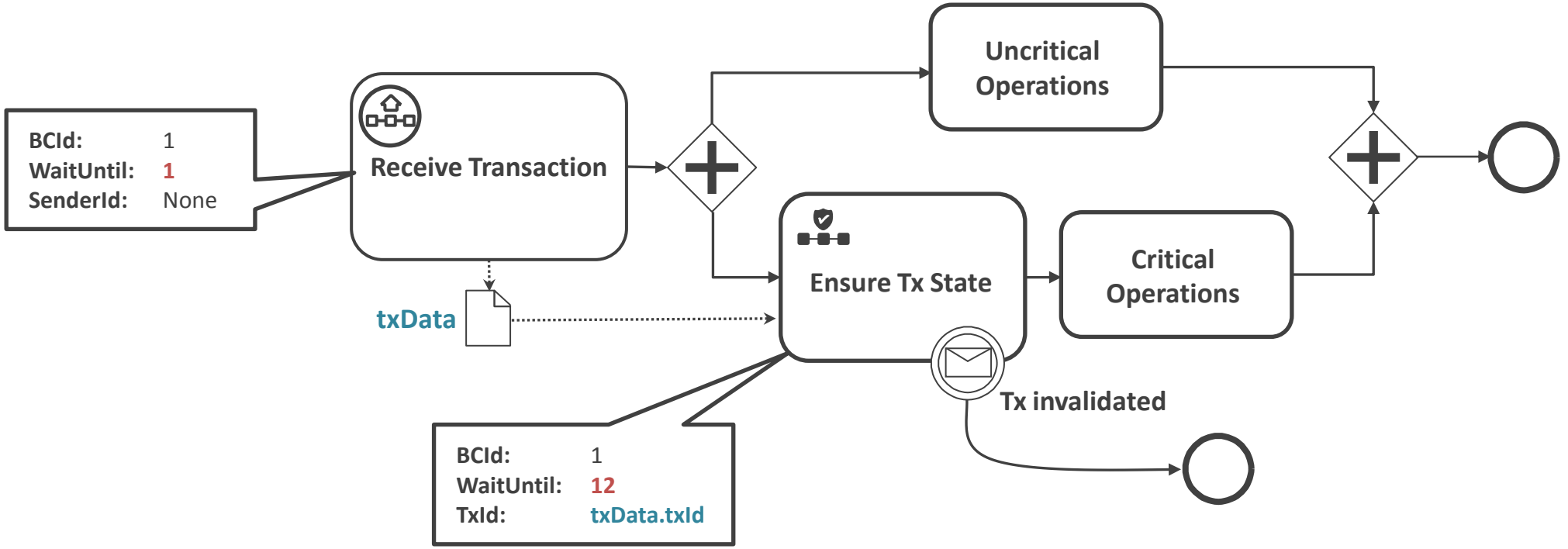
Operation	Subscription Type
submitTransaction	One-shot
receiveTransaction	One-shot
receiveTransactions	Durable
detectOrphanedTransaction	One-shot
ensureTransactionState	One-shot

Blockchain-aware Modeling Extension (BlockME)

- Set of blockchain-aware **tasks** and **events**.
- Captures the **semantics** of blockchain-transactions and allows making **trade-offs**.
- Has the **visual appearance** of BPMN 2.0 artifacts.
- Can be transformed into **standard-compliant** BPMN 2.0.

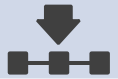
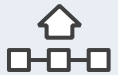
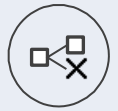
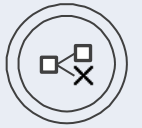
BlockME – Sample Use-Case

- Receive money transaction through blockchains, and based on it, execute some critical operations (sending a product), and some uncritical operations (sending confirmation to client):



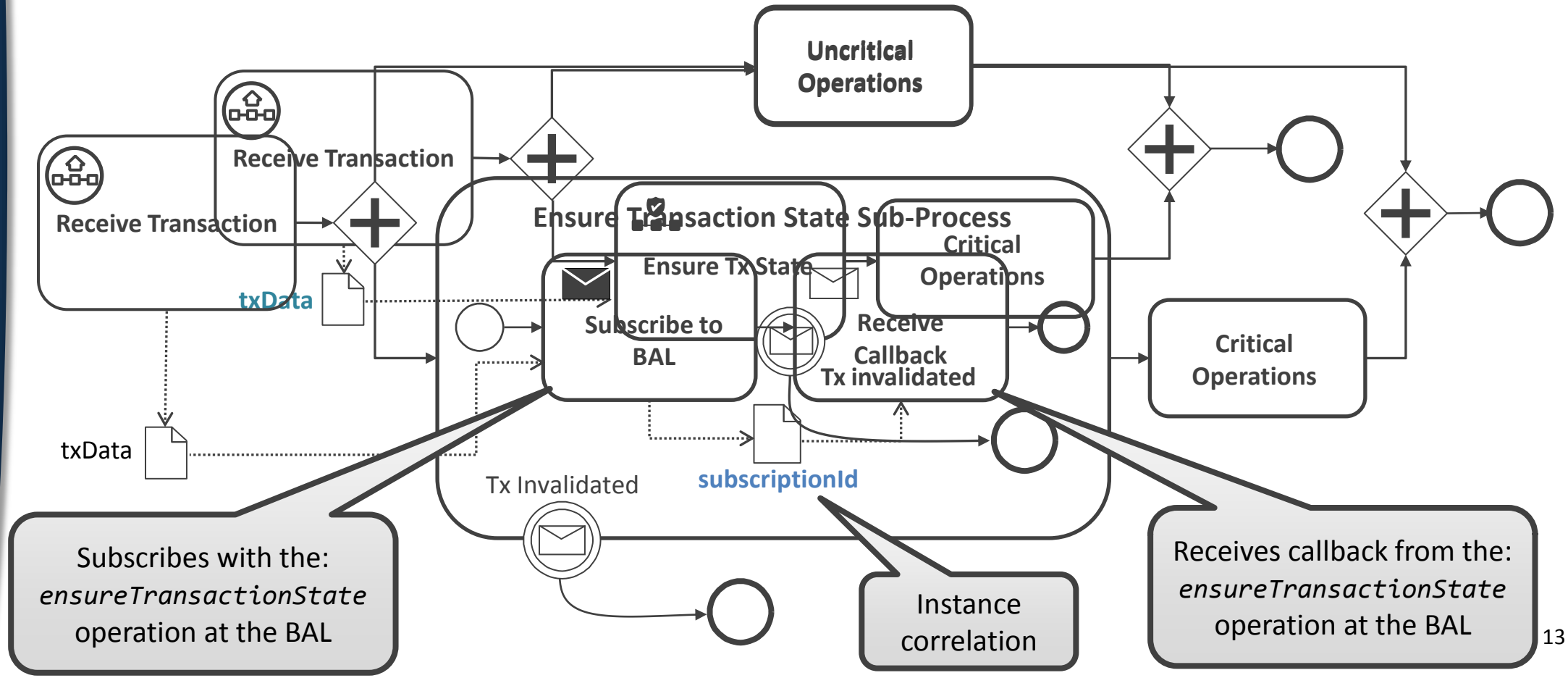
BlockME – Artifacts

- Extension artifacts are designed to communicate with the blockchain-access layer

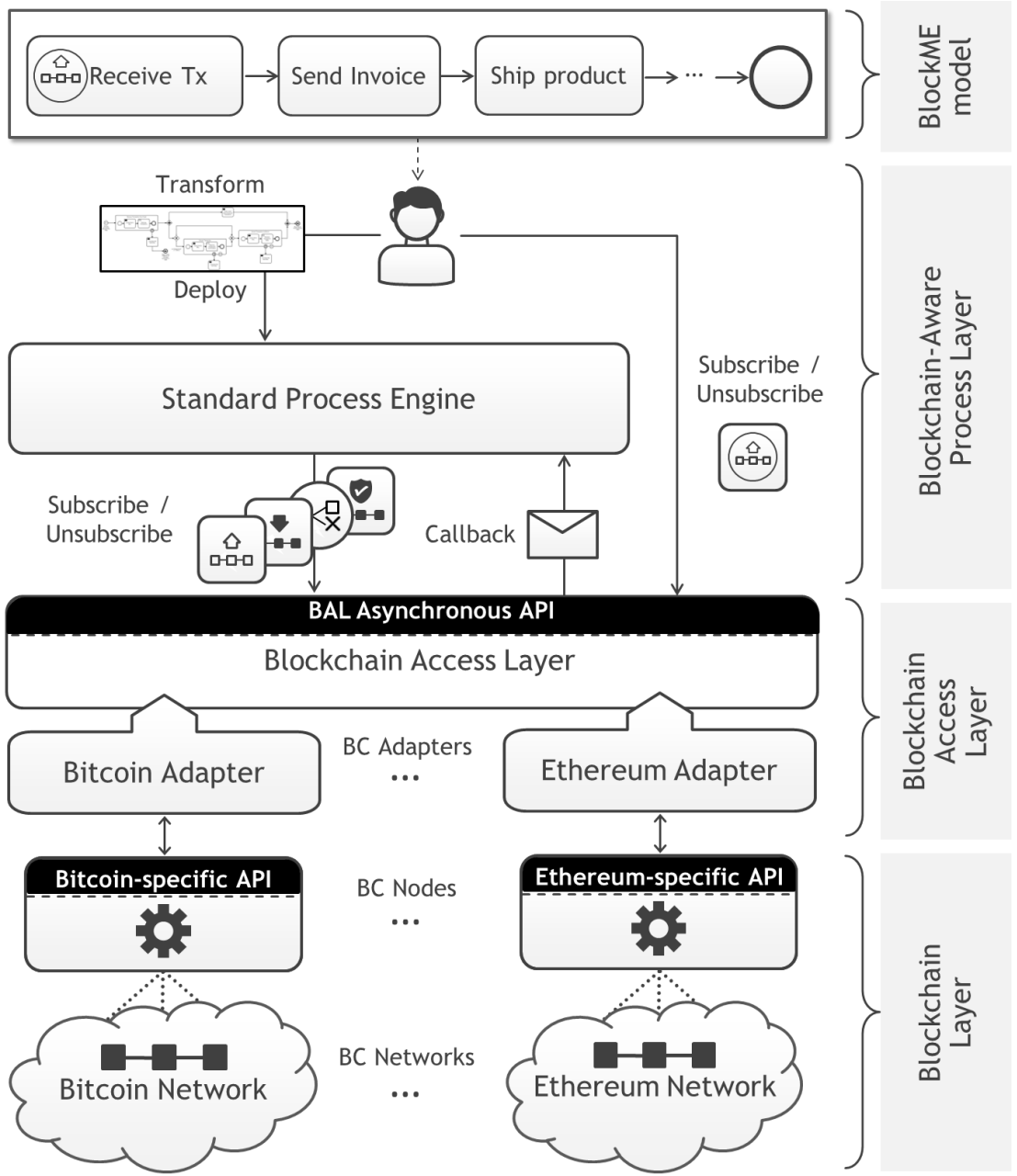
Operation	Subscription Type	Extension Artifact	Icon
submitTransaction	One-shot	Submit Transaction / **Task**	
receiveTransaction	One-shot	Receive Transaction / **Task**	
receiveTransactions	Durable	Receive Transactions / **Start Task**	
detectOrphanedTransaction	One-shot	Detect Orphaned Transaction / **Event Subprocess, Boundary Event**	 
ensureTransactionState	One-shot	Ensure Transaction State / **Task**	

BlockME – Transformation into Standard BPMN 2.0

- BlockME artifacts are transformed into a pair of message sending and message receiving tasks that communicate with the BAL asynchronously:



Method and System Architecture



Conclusion

- Identified the issue with blockchain transactions durability.
- Introduced the BlockME-method to model, transform and deploy blockchain-aware business processes.
- Introduced the Blockchain Access Layer that allows communication between blockchains and external applications while explicitly handling uncertainty.

Thank you!