On Multilateral Agreements And Multidomain Applications

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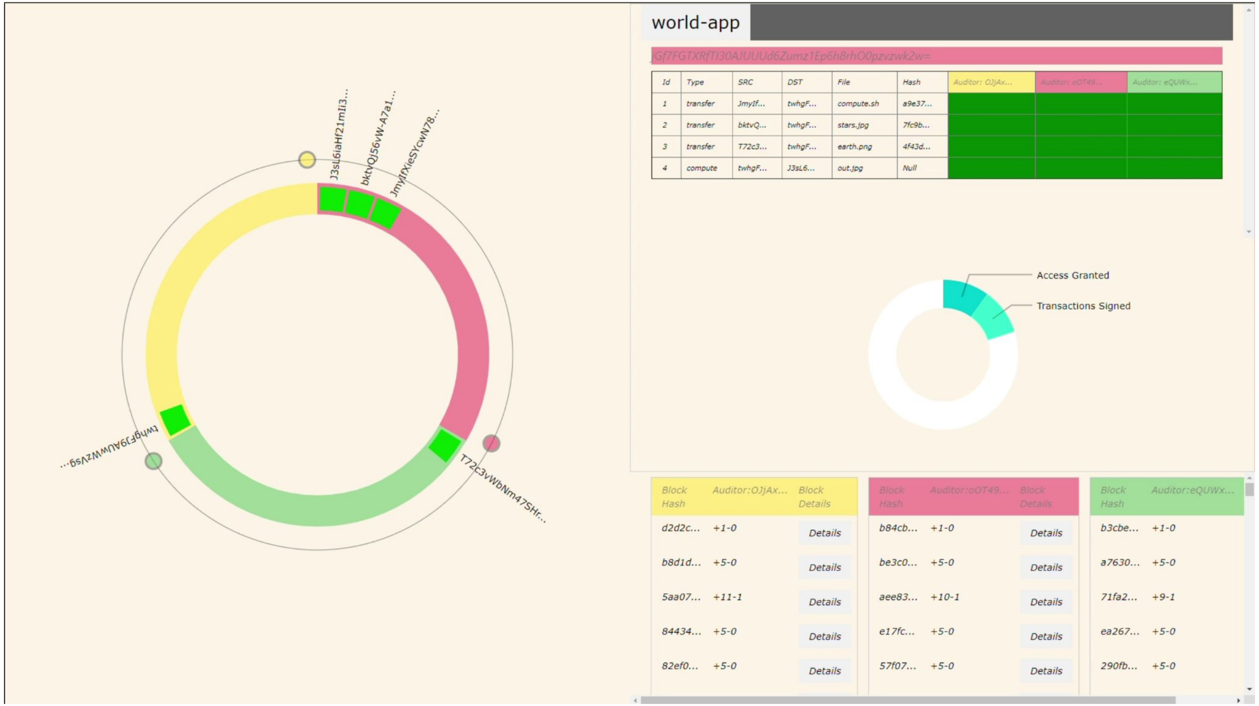
Story so far...

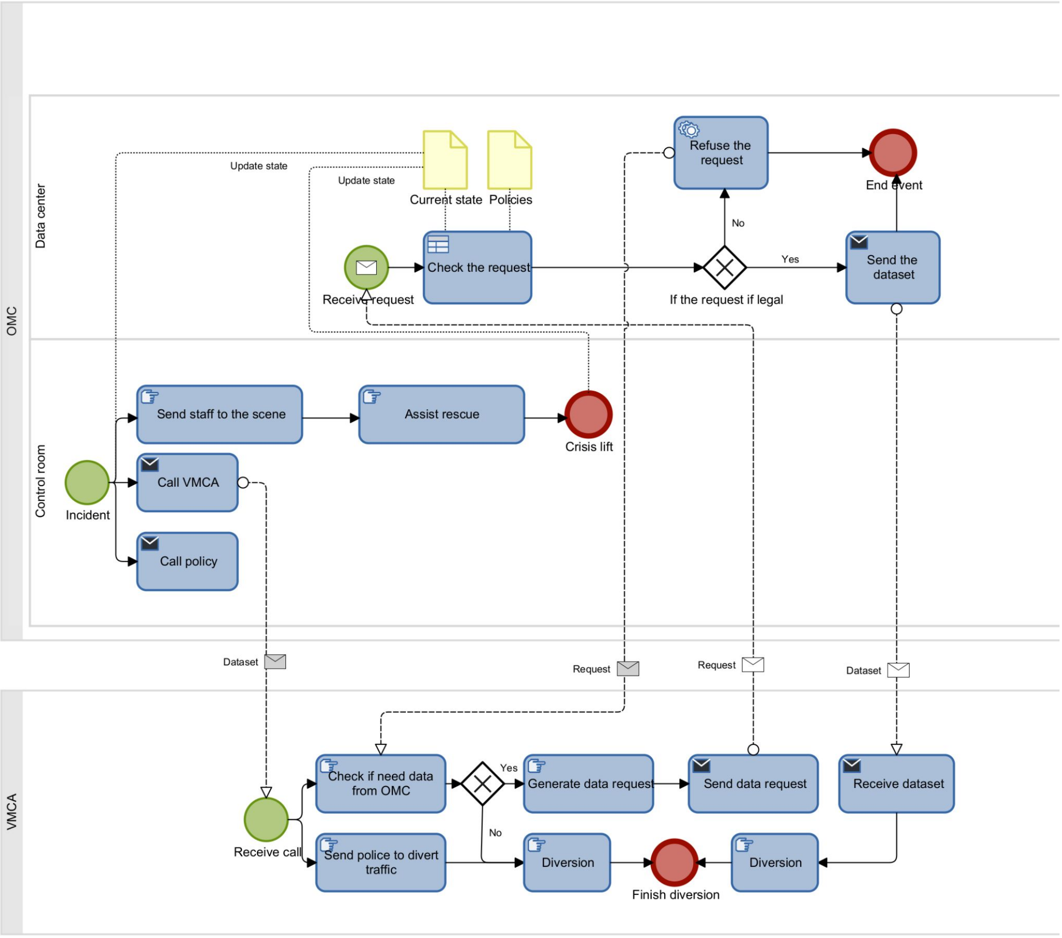


- **Actors** = Containers
- Actors cryptographically addressed
- Multidomain communication through MQ using actor keys as topics.
- **Auditor** actors give permission to actors to carry out actions
- **Planner** actors encapsulate the notion of a workflow
  - Planners coordinate with auditors to execute workflow

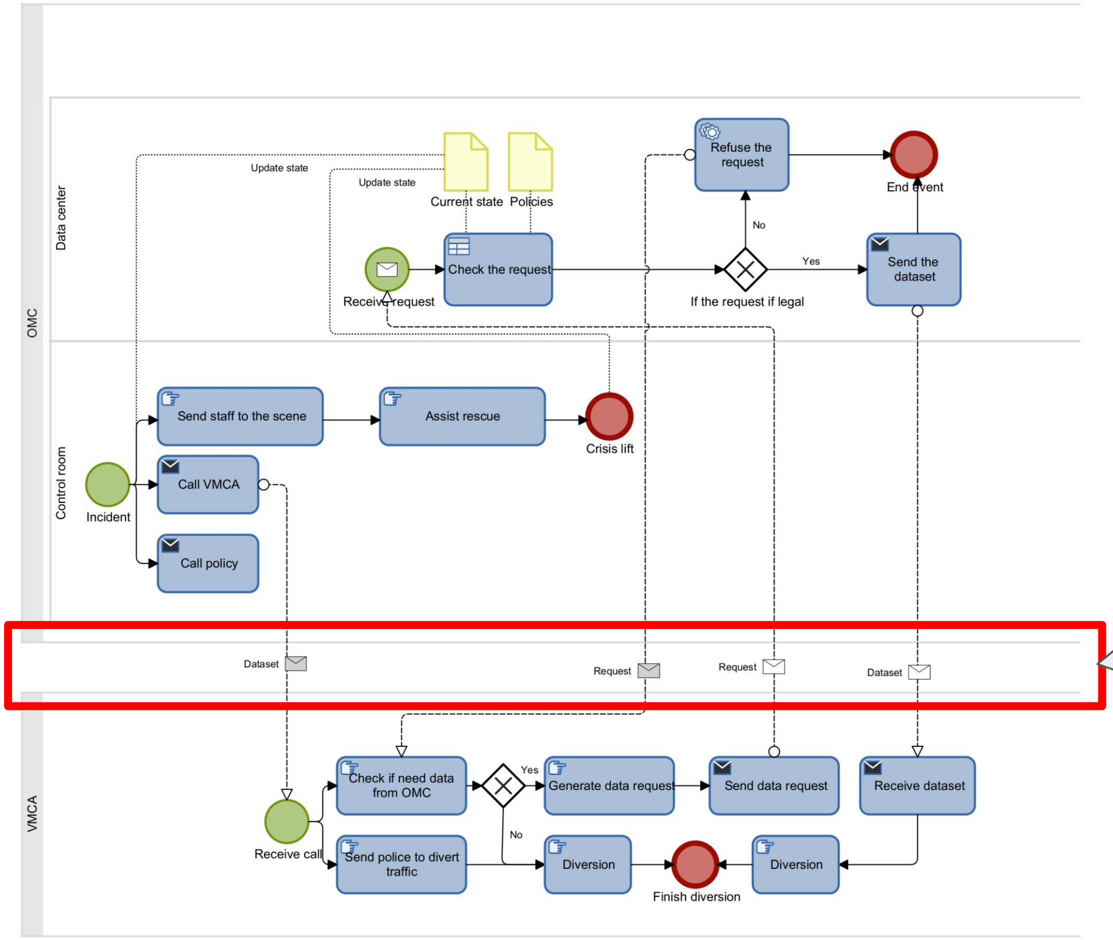
Moving forward...multi-domain coordination

- A multidomain application is a workflow whereby the (data|control)flow crosses domain boundaries.
- Domain boundaries are controlled through rules/agreements derived from policies.
- A use case can be considered as having multiple facets.
  - The application functional components (functions)
  - The data assets
  - The coordination logic (controlflow)
- Controlflow is a program in itself that is *owned* by multiple domains.
- The challenge is:
  - *How to execute a control program owned by multiple domains?*

ArenA use-case multi-domain process model in BiZZdesign

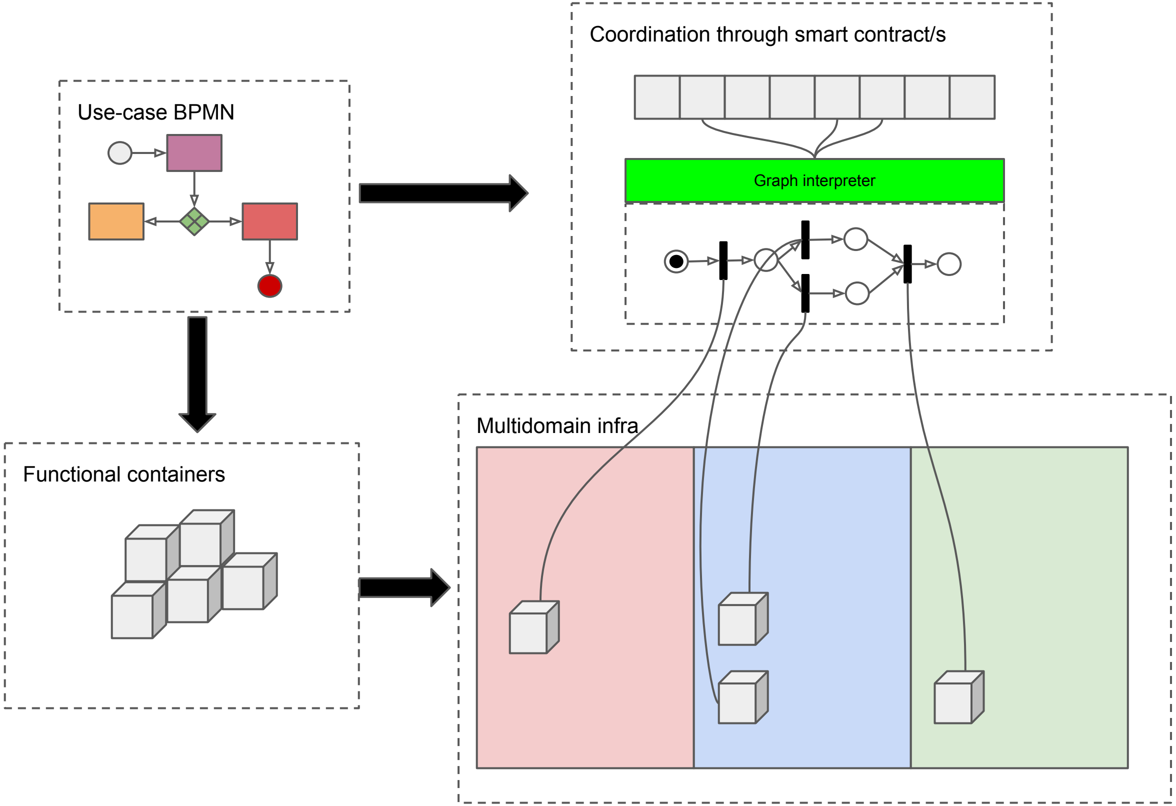


ArenA use-case multi-domain process model in BiZZdesign

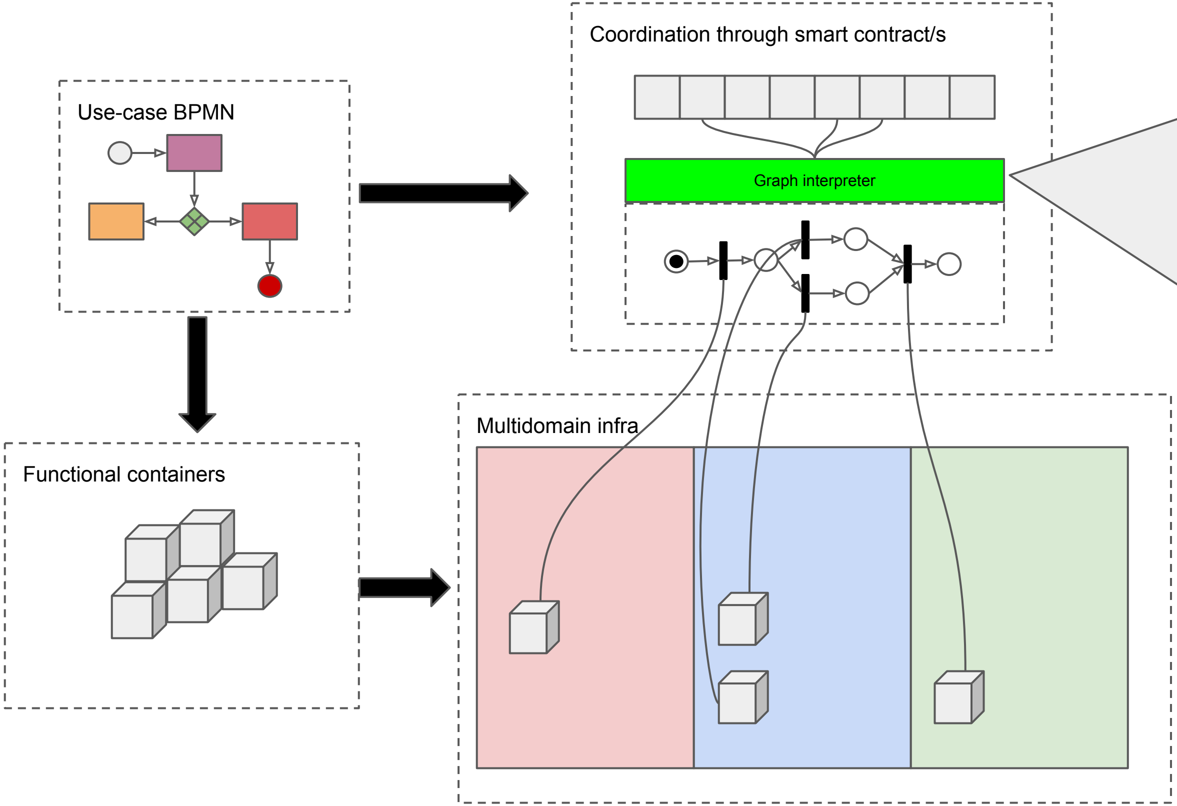


- Track, control, coordinate cross-border processes.
- Traditionally a **static** layer using API keys etc.
- In a marketplace we propose a **programmable** layer.
- We need to capture and coordinate these set of rules in a transparent and secure way.
- We propose state machines to keep track of the state of the border.
- Each party/domain updates the state machine thus signaling the other parties to take action.

Process model to infrastructure

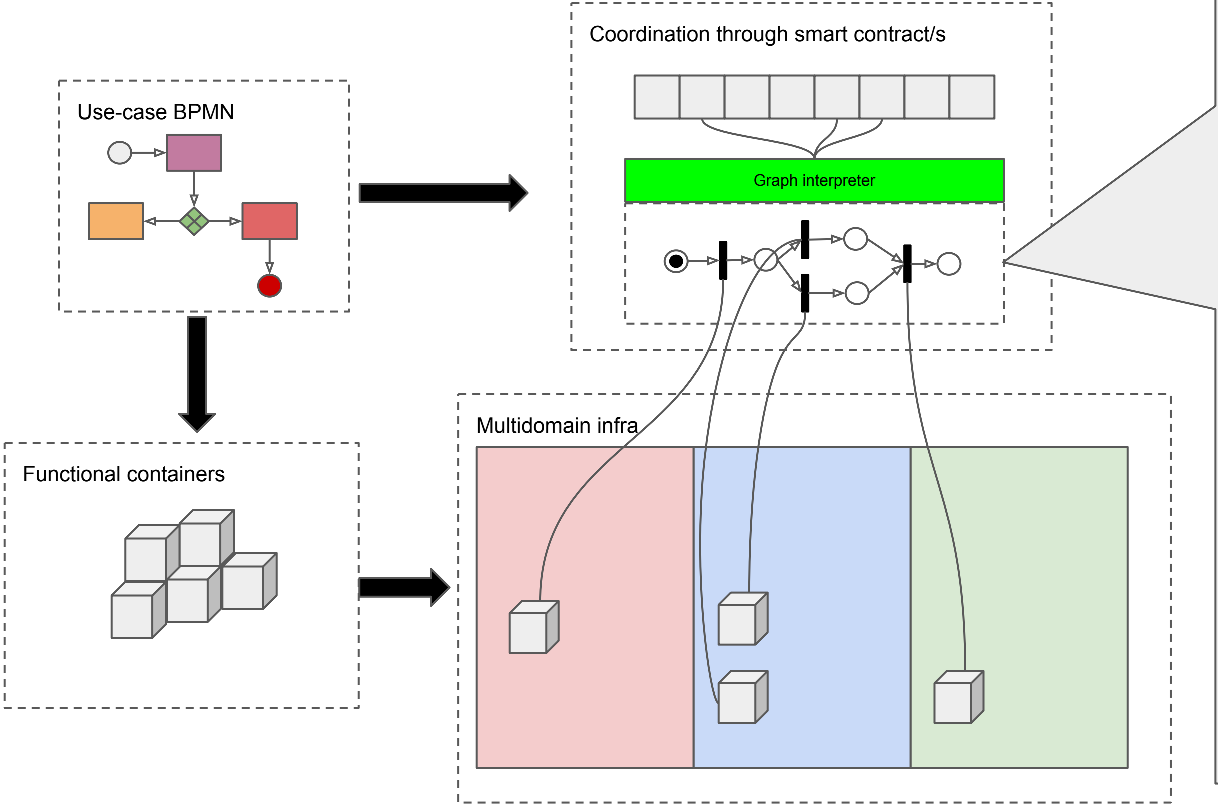


Process model to infrastructure



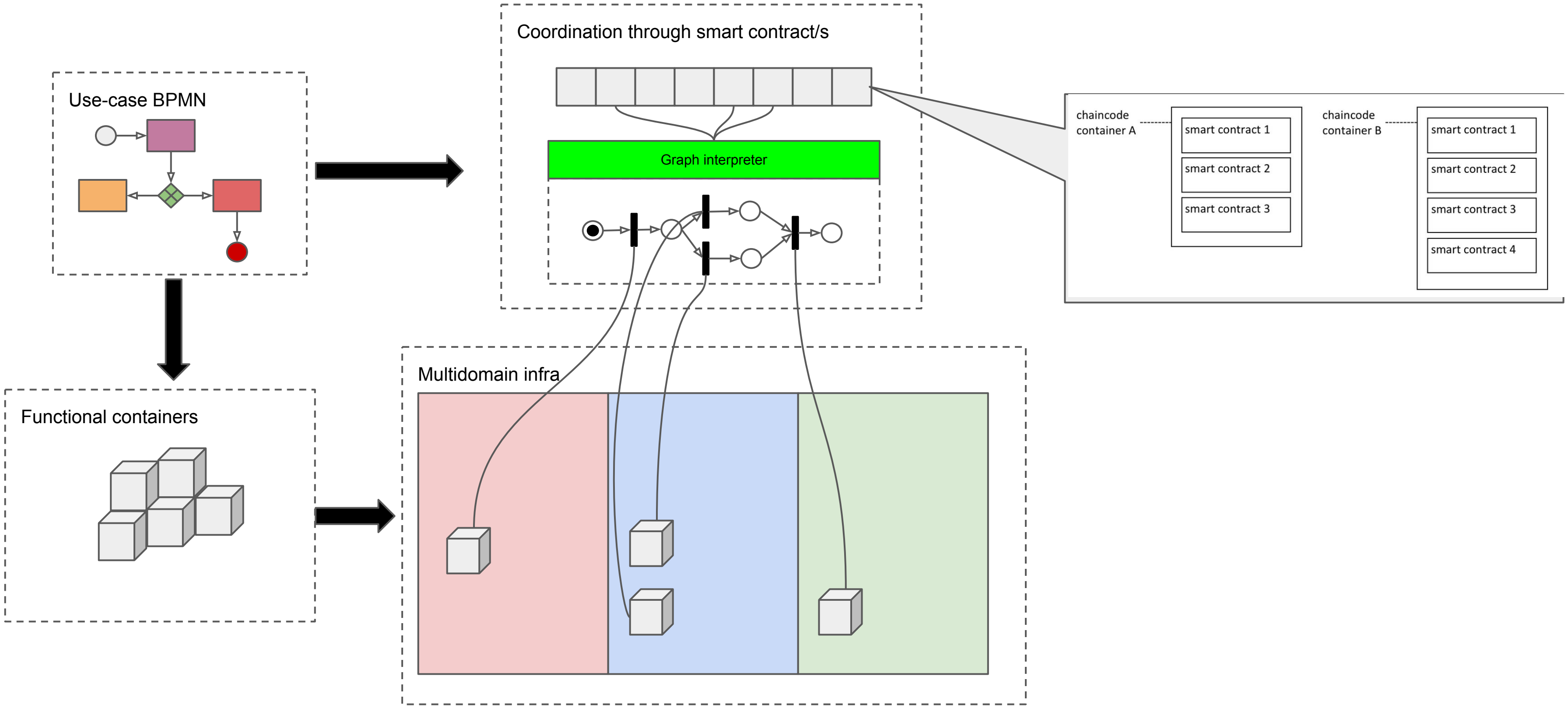
- **Generic** dataflow/petrinet executor running on a blockchain i.e. every peer is running the executor.
- Domains/actors are assigned a set of tokens.
- Actors define functions as a task with token input, token outputs and webhooks to interact with the outside world.
- So actors own tokens and tasks
- A task needs certain amount of tokens to **fire**
- Blockchain transactions copy tokens between actors.
- When a task has enough input tokens it will **fire** which in turn generates blockchain events.
- Containers monitor the ledger to trigger a process inside a container (the task).
- The container will make blockchain transactions to signal the task is completed and move the state machine.

Process model to infrastructure



- a petrinet that regulates how multi parties collaborate.
- the rationel is that a party can only perform a certain task given a certain context.
- Context is a set of multi domain preconditions that have to met.
- The movement of tokens within the graph changes the context.
- Tasks running outside the their agreed context are deemed as illegal.
- The approach should be generic enough that it can be applied to event driven scenarios.
- Petrinets have strong mathematical foundations.
- Can be analysed for behaviour and structure properties e.g. reachability, boundedness liveness, reversibility, coverability...

Process model to infrastructure



Beneath the blockchain buzz words; a computer scientist’s view

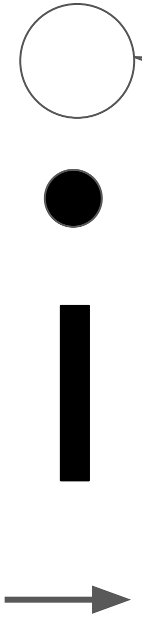
- Is a distributed database.
- Instead of storing the DB data, store the transactions the made the data.
- Data **‘asset|token’** is cryptographically signed data struct by users **‘owners**’.
- Changing owner’s signature of data is a **‘transaction’.**
- Users have pki keys. **‘accounts|wallets**’.
- Use a linked list to store the transactions **‘blockchain**’.
- Reference(hash) the previous list’s recordset **‘block’** in the new block.
- Multiple nodes need to agree on recordset order **‘consensus**’.
- Multiple nodes can rebuild the data from the linked list.
- Since multiple nodes can do *something* then they can also run scripts **‘smart contracts’**.
- End result is a distributed network that can run deterministic scripts to manipulate a shared linked list where records are owned by different users.

Blockchain primitives

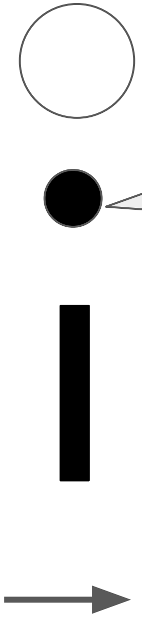
- Participants
  - Users with an x509 cert given by a CA peer on the network.
- Assets
  - User defined data structs owned by a participant.
  - **Cryptographically signed** data structs.
- Transactions
  - Move assets between participants
- Chaincode(smart contracts)
  - Javascrip/go/java programs to create programs with these primitives.
  - The chaincode runs on all/multiple peers of the network
  - Transactions are recorded in the DB(Ledger)
- The challenge:
  - How to map the controlflow program to a chaincode.
  - Make it generic.
  - How to interface actors to the chaincode (we want actors to affect state changes in the controlflow)

Petrinet to blockchain mapping

- A place receives is a placeholder for tokens.
- It is owned by a domain.
- Can be represented as an Asset.

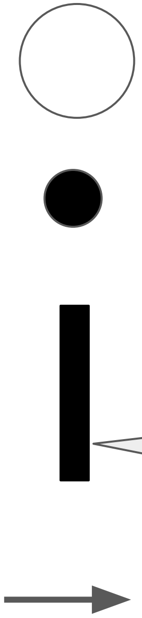


Petrinet to blockchain mapping



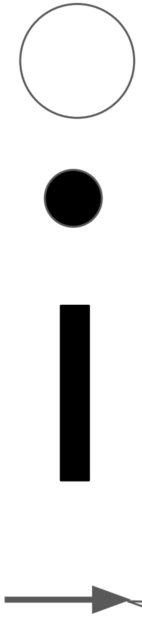
- Tokens are passed between places.
- They are owned by domains.
- They are represented as assets.
- Tokens change ownership when moved between places.
- As is with web tokens, tokens also represent authorization. A function can only execute if it has to correct tokens from the different domains.

Petrinet to blockchain mapping



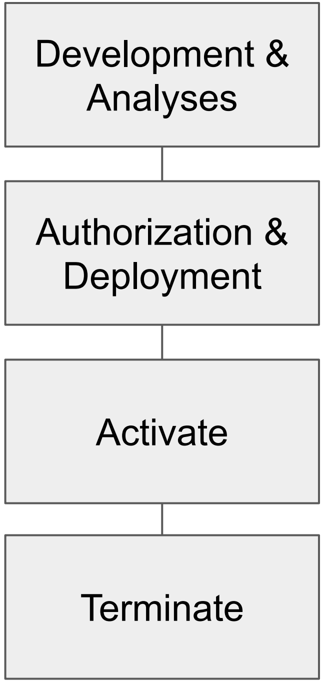
- Transitions are what move tokens between places.
- They are represented as an asset.
- They are owned by domains.
- They map to container functions.
- A transition fire implies a container function execution.

Petrinet to blockchain mapping



- Arrows show the control flow of the network.
- They indicate the required input tokens for a transition and the number of output tokens.
- A transition (container function) fires when the required input tokens are ready.

Petrinet life cycle



Develop the petrinets as ‘smart contracts’. Analyse petrinets. We can only deploy once to a blockchain.

Deployment needs authorization from multiple peers on the network. This will need an audit layer to authorize deployments.

Once deployed it is in a start state. Moving from the start state activates the petrinet.

A petrinet can terminate it can not move to any other state.