New America: Open Asset Repatriation System (OARS)

Quick Start

23th December 2020

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Summary

Corruption and stolen public assets represent an unprecedented problem with a staggering effect on the growth of some developing economies. This theft diverts valuable public assets from intended purposes: addressing social issues and public services. The asset recovery process helps to reclaim and return the stolen proceeds to the victim country from which they were taken. However, the repatriation of the stolen assets is usually complex, lengthy and involves multiple legal jurisdictions. In addition, concerns remain about repatriating the assets to countries where corruption is still endemic. The lack of transparency and accountability in the repatriation of assets presents a major challenge in restoring trust among citizens and governments as well as in advancing the fight against international crime and corruption.

To facilitate transparency and accountability around the disposition of assets returned by the United States to a recipient country, New America aims to build an open-source Distributed Ledger Technology (DLT) platform: Open Asset Repatriation System (OARS) that leverages Corda's peer-to-peer communication, smart contract, and consensus between transacting parties. By providing immutable records of asset issuance, transfer and withdrawal, this platform will provide a transparent trail of evidence, enhancing transparency and accountability in asset repatriation to the U.S. Government, the recipient country, and other relevant parties such as civil society organizations.

Corda Key Concepts

- **Status** - The status represents shared facts on the ledger
- **Transactions** - The transactions update the ledger status
- **Contracts** - The contracts govern how status can evolve over time
- **Flows** - The flows describe the interactions that must occur between parties to achieve consensus (to satisfy some business requirement)
- **Consensus** - How parties on the network reach consensus about shared facts on the ledger
- **Notaries** - The component that assures uniqueness consensus (prevents double spends)
- **Vault** - The component that stores on-ledger shared facts for a node
- **Participants** - The nodes that participants in on-ledger transactions

Use Case

The initial focus for New America is developed around two scenarios of asset repatriation from the U.S. to a recipient country. The final proof of concept (PoC) encompasses two possible scenarios, with “Catan” (a fictitious country) as the recipient country until a real-world recipient country is selected by the U.S. Government. The scenarios are presented in ascending order, from the scenario that is anticipated to likely be the easiest to process politically but will provide a lower degree of transparency and accountability; to a scenario that provides the most transparency and accountability but requires the most political will from Catan to implement. The scenarios are written from a high-level business perspective. The next section (Business Process Modelling Notation) details each scenario into steps that happen off-ledger and steps that happen on ledger.

Each of these scenarios relies on the same key assumptions:

1. Funds are fully returned in a single transfer by the U.S. Government to Government of Catan. The returned funds are based on a bilateral agreement which may include a designated use for the returned funds.
2. Transactions on ledger only represent virtual fund movement between actors – the funds will not be moved among real-world financial institutions (see #5 below).
3. The assets involved in the transactions are fiat currency.
4. There are varying degrees of political will underlying the scenarios, as well as degrees of transparency and accountability.
5. External services, such as designated commercial banks, will be handling actual assets. How the CorDapp receives data from these services will be bespoke to the recipient country.

Note: The difference between Scenario 1 and Scenario 2 is that Scenario 1 represents the Catan Government as fully sovereign in overseeing the returned assets with the U.S. Government having only visibility. As such, Scenario 1 only has Catan Ministry of Justice as the required approver of the request with U.S. officials granted transparency into actions. Whereas Scenario 2 represents a case where bilateral cooperation is stronger and high levels of accountability are desired and as such the U.S. Department of State, U.S. Department of Justice, Catan Ministry of Justice, Catan Ministry of Foreign Affairs will each have a role in the approval process for funding requests.

Scenario 1: Medium Transparency

This is basis for OARS Prototype

- U.S. Government returns the agreed assets in full to the Government of Catan. U.S. Government will also set parameters to track irregular activity on the recipient countryside. For example, limitations on maximum withdrawal amounts or other systemic parameters.
- Catan Treasury acknowledges receipt of funds from U.S. Treasury.
- Government of Catan via Ministry of Foreign Affairs coordinates a list of authorized agencies that can withdraw the repatriated funds.
- Authorized agencies can send transfer requests to Catan Ministry of Justice to fund an initiative with an indication of purpose and destination bank account number.
- OARS system flags suspicious requests. A designated official from Catan Ministry of Justice must approve and sign off on requests. The user interface displays all requests as approved, rejected, transferred, and flagged.
- If Catan MoJ approves the request, the requested transfer will be linked to the account for a specific asset return which will fund the approved project/initiative and also linked to the account for the government agency tasked with the project/initiative implementation. If Catan MoJ rejects the request, the Catan official will enter a reason for the rejection in the system.
- Catan Treasury transfers the amount of money in the approved request to the authorized agency/user.
- U.S. Department of State, U.S. Department of Justice, New America, Catan Ministry of Foreign Affairs, Catan Ministry of Justice, and Catan Treasury have visibility into full withdrawal and transfer records and up-to-date balance of the original fund.
- Catan Approved Agencies, U.S. CSO and Catan CSO have partial visibility into the fund transfer requests. Catan Approved Agencies will not see individual names of Catan Official that approved/rejected the requests. CSOs will also have similar limited views and will not be able to see bank account details.

The Administrator will have similar visibility as the Government users, ability to onboard new users and the system entitlements. The Administrator and the U.S Government users will have access to see the Node Explorer, which is the visual tool of the DLT recorded transactions.

Scenario 2: High Transparency

This is a proposed high transparency workflow flow that involves the U.S. Government in the approval process. This was not built into the prototype

- U.S. Government returns the agreed assets in full to the Government of Catan. U.S. Government will also set parameters to track irregular activity on the recipient countryside. For example, limitations on maximum withdrawal amounts or other systemic parameters.
- Catan Treasury acknowledges receipt of funds from U.S. Treasury.
- Government of Catan via Ministry of Foreign Affairs coordinates a list of authorized agencies that can withdraw the repatriated funds.
- Authorized agencies can send transfer requests to Catan Ministry of Justice to fund an initiative with an indication of purpose and destination bank account number.
- OARS system flags suspicious requests. Given the bilateral cooperation, designated officials from ***both*** the U.S. and Catan Governments will approve and sign off the non-flagged requests. If any of the designated officials from either U.S. or Catan governments do not approve the transfer request, the request will be rejected. The user interface displays all requests as approved, rejected, transferred, and flagged.
- For approved requests, the requested transfer will be linked to the account for a specific asset return which will fund the approved project/initiative and linked to the account for the government agency tasked with the project/initiative implementation. For rejected requests, officials will enter a reason for the rejection in the system.
- For fully approved requests, Catan Treasury transfers the amount of money in the approved request to the authorized agency/user.
- U.S. Department of State, U.S. Department of Justice, New America, Catan Ministry of Foreign Affairs, Catan Ministry of Justice, and Catan Treasury have visibility into full withdrawal and transfer records and up-to-date balance of the original fund.
- All approved agencies, U.S. CSOs and Catan CSOs have partial visibility into the fund transfer requests but will not see individual names of the officials that approved/rejected the requests. CSOs will also have similar limited views and will not be able to see bank account details.
- The Administrator will have similar visibility as the Government users, ability to onboard new users and the system entitlements. The Administrator and the U.S

Government users will have access to see the Node Explorer, which is the visual tool of the DLT recorded transactions.

Actors, Roles and Data Visibility

A word about Observer Nodes

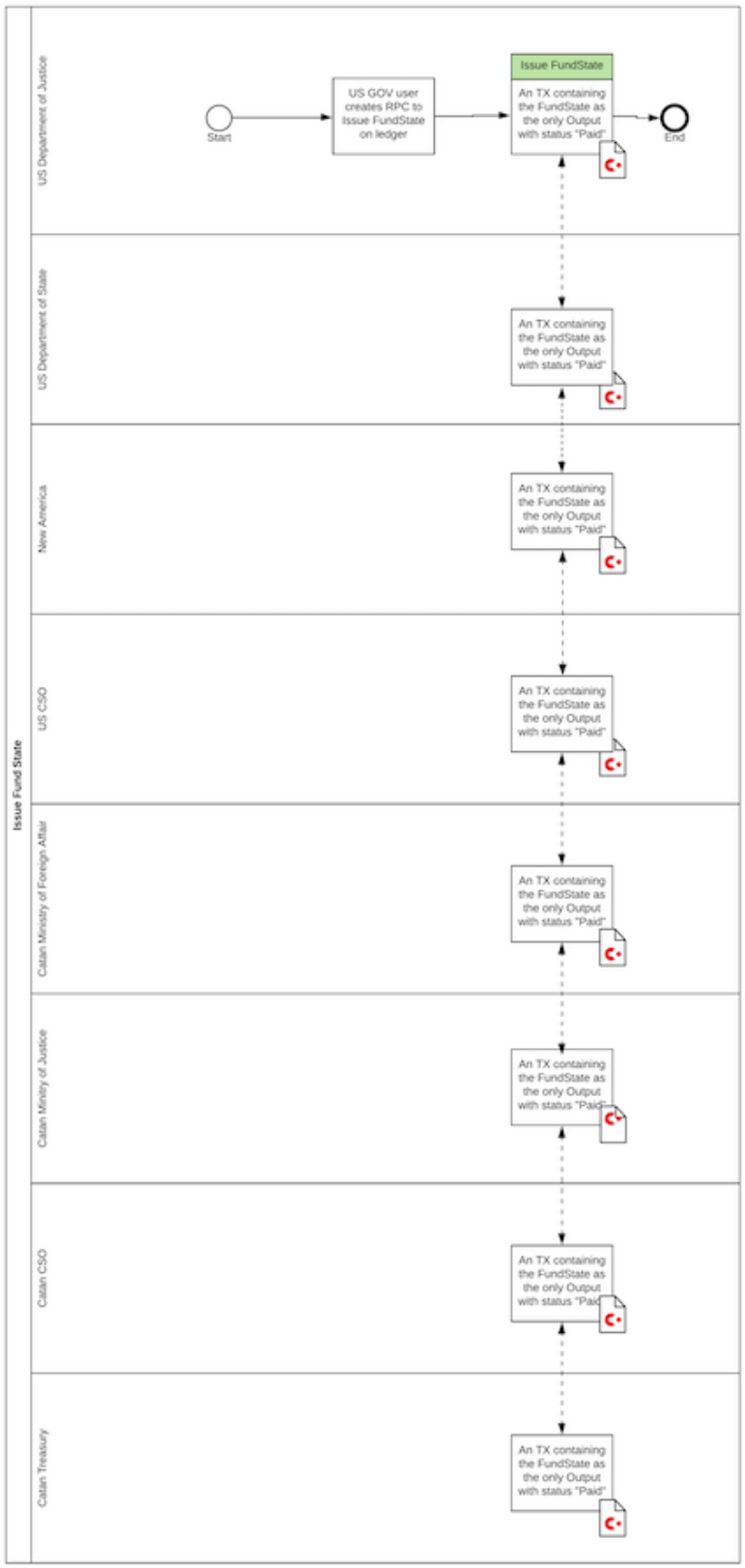
Posting transactions to an observer node is a common requirement in many real-world use cases, where regulators want to receive comprehensive reporting on all actions taken. Determined by actors' roles and their data visibility requirements, U.S. CSOs and Catan CSOs are going to be observer nodes in these scenarios. They can receive a stream of digitally signed, attested reports useful for later auditing and processing without participating in on-ledger transactions.

Note: The following actors are business participants.

Actor	Role	Data Visibility
U.S. Department of State	- Work with the U.S. Department of Justice - Record issuance of asset on to the ledger - (Scenario 2) Designated officials can approve or reject requests from Catan's authorized users	- Fund status and fund balance over time - Withdraw or transfer records of the fund
U.S. Department of Justice	- Work with the U.S. Department of State - (Scenario 2) Designated officials can approve or reject requests from Catan's authorized users	- Fund status and fund balance over time - Withdraw or transfer records of the fund
U.S. Treasury	- Transfer asset from the U.S. Treasury to Catan Treasury (physically)	- U.S Treasury is not a Corda node and it does not participate in on-ledger transactions
New America	- Administrator of the OARS platform - Onboard new users by issuing system entitlement	- Fund status and fund balance over time - Withdraw or transfer records of the fund

Actor	Role	Data Visibility
	- Monitor records logged on the digital ledger from all participants	
U.S. CSO	- An observer of partial transactions on ledger	- Fund status and fund balance over time - Partial withdraw or transfer records of the fund (no visibility of authorized user and no visibility on account details)
Approved Agency	- (Scenario 1&2) Provide a list of authorized users - Role of implementing project/initiative	- transfer records - status of: “PENDING; “APPROVED” “REJECTED”; “TRANSFER” - Does not see usernames or account details - Does not see rejection reason
Catan Ministry of Justice	- (Scenario 1&2) Approve or reject requests from authorized users - (Scenario 1&2) Update fund balances - (Scenario 1&2) Issue partial withdraw or transfer records to CSOs	- Fund status and fund balance over time - Withdraw or transfer records of the fund
Catan Treasury	- Acknowledge the receipt of funds from US - Transfer funds to authorized users in Catan	- Fund status and fund balance over time - Withdraw or transfer records of the fund
Catan CSO	- An observer of partial transactions on ledger	- Partial transfer records of the fund (no visibility of authorized user and bank account details)

Business Process Modelling Notation



[Lucid Chart]

Scenario 1: Medium Transparency

Workflow Steps 1-9 are the same for Scenarios 1&2. Steps 10-15 are unique to Scenario 1. A designated official from the Catan Ministry of Justice needs to approve or reject the requests from the authorized user of the approved agency. Steps that happen on ledger are written in blue. (Please refer to Cordapp CDL section for details of the Fund state, Request Fund state, and Partial Request Fund state, i.e., data that get recorded on ledger) Note: A valid request means the requested amount is lower than or equal to the balance and lower than or equal to the maximum withdrawal amount. Corda smart contracts will automatically check all incoming requests and flag invalid requests. Additional conditions for determining valid requests may be added after the PoC.

Step 1. U.S Treasury transfers the funds to Catan Treasury/Central bank.

Step 2. A user from the U.S Department of Justice will use OARS to enter the relevant account information for the repatriated assets. A record will be created on the ledger with the recipient country, asset amount returned and the recipient country's destination account number for audit purposes. The U.S. DOJ will also set a maximum withdrawal limit for approved agencies. This is used to track potential irregular activity. *Once complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.*

Step 3. A Fund State is issued on-chain to represent the transfer of funds in an off-ledger bank account from the U.S Treasury to Catan Treasury. The Fund State is created in the "ISSUED" status.

Step 4. A Catan Treasury user logs into OARS and acknowledges that s/he/they have received the funds. *Once complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.*

Step 5. This kicks off a "Receive Fund" flow on Corda which sets the isReceived flag to TRUE.

Step 6. An authorized user from an approved agency, such as Catan Ministry of Education[1] , can log into OARS and sends a transfer request to Catan Ministry of Justice. The authorized user will provide the requested amount, intended use of the money, and approved agency destination bank account number. Each request will

[1] Note: the Catan Ministry of Education is meant to be an example of a type of user authorized by the Catan government to withdraw funds from the repatriated funds. The approved organization is established within recipient country outside of the OARS system. The choice of the specific Ministry is simply illustrative. The Ministry itself is not a node on the ledger but does have access to the front end of OARS to be able to initiate withdraw requests.

indicate if the status is “PENDING” or “FLAGGED” for U.S. and Catan Government officials. Approved Agencies and CSOs will see all requests as “PENDING” prior to approval or rejection. *Once complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.*

Step 7. This kicks off a "Send Request" flow on Corda which sends the RequestFund state to Catan Ministry of Justice.

Step 8. A RequestFund state issued on ledger with "ISSUED" status.

Step 9. Corda checks the maximum withdrawal amount against the requested amount and marks requests that breaches the maximum withdrawal amount as "FLAGGED". Non flagged requests receive a status "PENDING".

Step 10. A designated official can see all requests (flagged or not flagged) and can approve and sign off transfer requests in OARS. The designated official will be notified by email about a pending approval. In scenario 1, the designated approver is on the recipient countryside. In this case, it is the Catan Ministry of Justice.

If Catan MoJ would like to approve a withdrawal request, s/he/they will link the withdrawal request to a specific asset return that has been entered in OARS.

If the recipient country has multiple returns that have not been fully allocated to approved agencies, then the Catan MOJ user can assign any transfer requests from implementing agencies, such as Catan Ministry of Education to a particular asset return account. This would allow tracing the projects or spending allocated to a particular return.

If Catan MoJ rejects a withdrawal request, the s/he/they will provide a reason for the rejection.

When approved or rejected, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.

Step 11. Upon approval and fund matching, the status of RequestFund state changes from "PENDING" to "APPROVED" in case of approval. A successful run of the "Update Balance" flow will produce an updated Fund State after approval of the request with the new balance and a PartialRequestFund state in OARS.

Step 12. U.S CSO and Catan CSO can see a partial details of approved agency transfer requests without the username, bank account details, and rejection details.

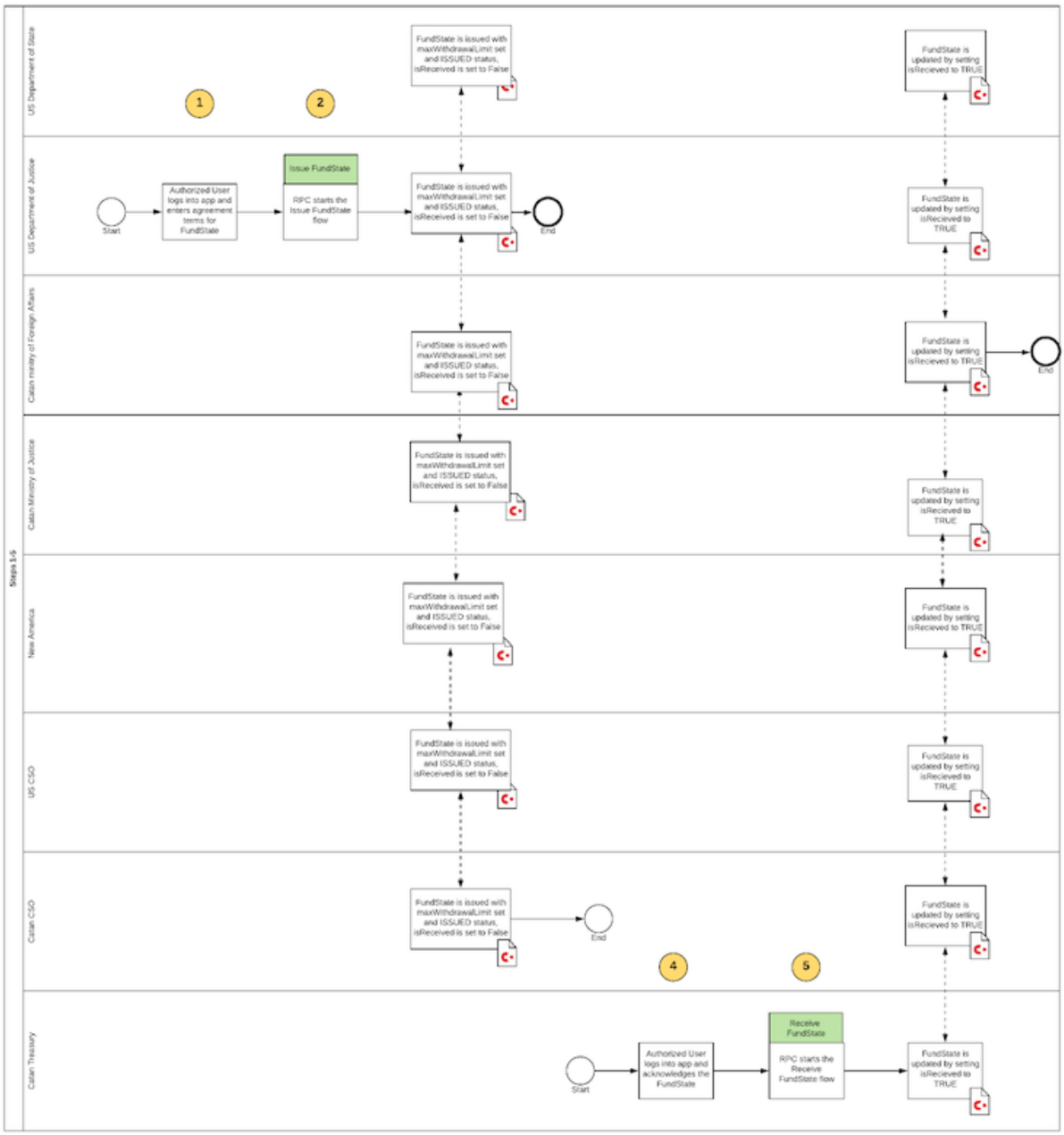
Approved agencies can see partial details of their transfer requests approved/rejected status. The authorized users will not see the username and if rejected, the reason for rejection also be withheld.

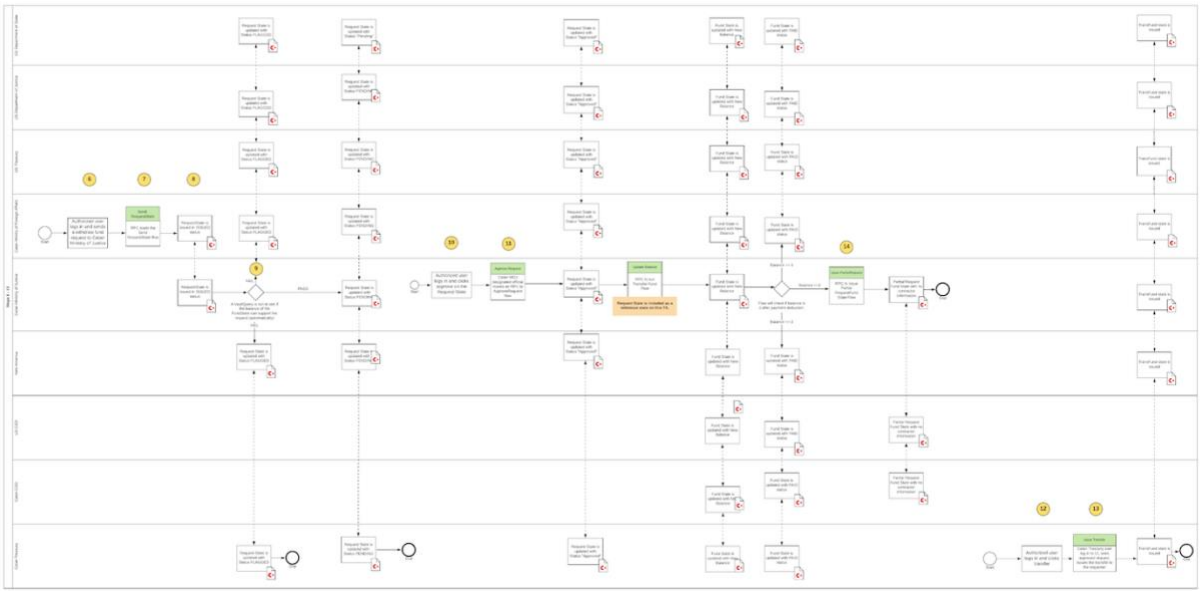
Step 13. A Catan Treasury user logs into the OARS and transfers the approved funds to the Catan Ministry of Education.

When transferred, optional configuration mail can be sent to Catan MoJ, Catan MoFA, and US DOJ, US State Dept can be implemented.

Step 14. A TransferFund state is issued on ledger.

Step 15. After the fund balance has been depleted, the Fund State status is set from "ISSUED" to "PAID".





[Lucid Chart]

Scenario 2: High Transparency

(Not in scope for the PoC and requires further requirements to build out the workflow)

Scenario 2 has the same Steps 1-9 as in Scenario 1. There are workflow differences in Steps 10-15. Any withdrawal of funds needs to be approved by four parties: Catan Ministry of Justice, Catan Ministry of State, U.S. Department of State and U.S. Department of Justice. Steps that happen on ledger are written in blue. (Please refer to Cordapp CDL section for details of the Fund State, RequestFund State, and PartialRequestFund State, i.e., the data that gets recorded on ledger)

Step 1. U.S Treasury transfers the funds to Catan Treasury/Central bank.

Step 2. A user from the U.S Department of Justice will use OARS to enter the relevant information for the asset repatriated. A record will be created on the ledger with the recipient country, asset amount returned and the recipient country's destination account number for audit purposes. The U.S. DOJ will also set a maximum withdrawal limit for approved agencies. This is used to track potential irregular activity. *Once complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.*

Step 3. A Fund State is issued on-chain to represent the transfer of funds in an off-ledger bank account from the U.S Treasury to Catan Treasury. The Fund State is created in the "ISSUED" status.

Step 4. A Catan Treasury user logs into OARS and acknowledges that s/he/they have received the funds. *Once complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.*

Step 5. This kicks off a "Receive Fund" flow on Corda which sets the Received flag to TRUE.

Step 6. An authorized user from an approved agency, such as Catan Ministry of Education[2] , can log into OARS and sends a transfer request to Catan Ministry of Justice. The authorized user will provide the requested amount, intended use of the money, and approved agency destination bank account number. Each request will indicate if the status is "PENDING" or "FLAGGED" for U.S. and Catan Government officials. Approved Agencies and CSOs will see all requests as "PENDING" prior to approval or rejection. *Once complete, optional configuration to send email to the*

[2] Note: the Catan Ministry of Education is meant to be an example of a type of user authorized by the Catan government to withdraw funds from the repatriated funds. The approved organization is established within recipient country outside of the OARS system. The choice of the specific Ministry is simply illustrative. The Ministry itself is not a node on the ledger but does have access to the front end of OARS to be able to initiate withdraw requests.

Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented.

Step 7. This kicks off a "Send Request" flow on Corda which sends the RequestFund state to Catan Ministry of Justice.

Step 8. A RequestFund state issued on ledger with "ISSUED" status.

Step 9. Corda checks the maximum withdrawal amount against the requested amount and marks requests that breaches the maximum withdrawal amount as "FLAGGED". Non flagged requests receive a status "PENDING".

Step 10. Designated users from Catan Ministry of Justice, Catan Ministry of Foreign Affairs, U.S Department of Justice and U.S. Department of State can see all requests (flagged or not flagged) and can either approve or reject transfer requests in OARS. A transfer request is considered approved once all designated users have unanimously signed off on the transfer request. If one ore more designated officials reject the requests, the transfer request will be considered as rejected. *Once each approval is complete, optional configuration to send email to the Catan MoJ, Catan MoFA, and US DOJ, US State Dept, US & Catan Treasury can be implemented. Once all approvals are complete, optional configuration to send email to the Catan Approved agency can also be implemented.*

Step 11. Upon approval by all designated approvers, the status of RequestFund state changes from "PENDING" to "APPROVED" in case of approval. A successful run of the "Update Balance" flow will produce an updated Fund State after approval of the request with the new balance and a PartialRequestFund state in OARS.

Step 12. U.S CSO and Catan CSO can see a partial details of approved agency transfer requests without the username, bank account details, and rejection details.

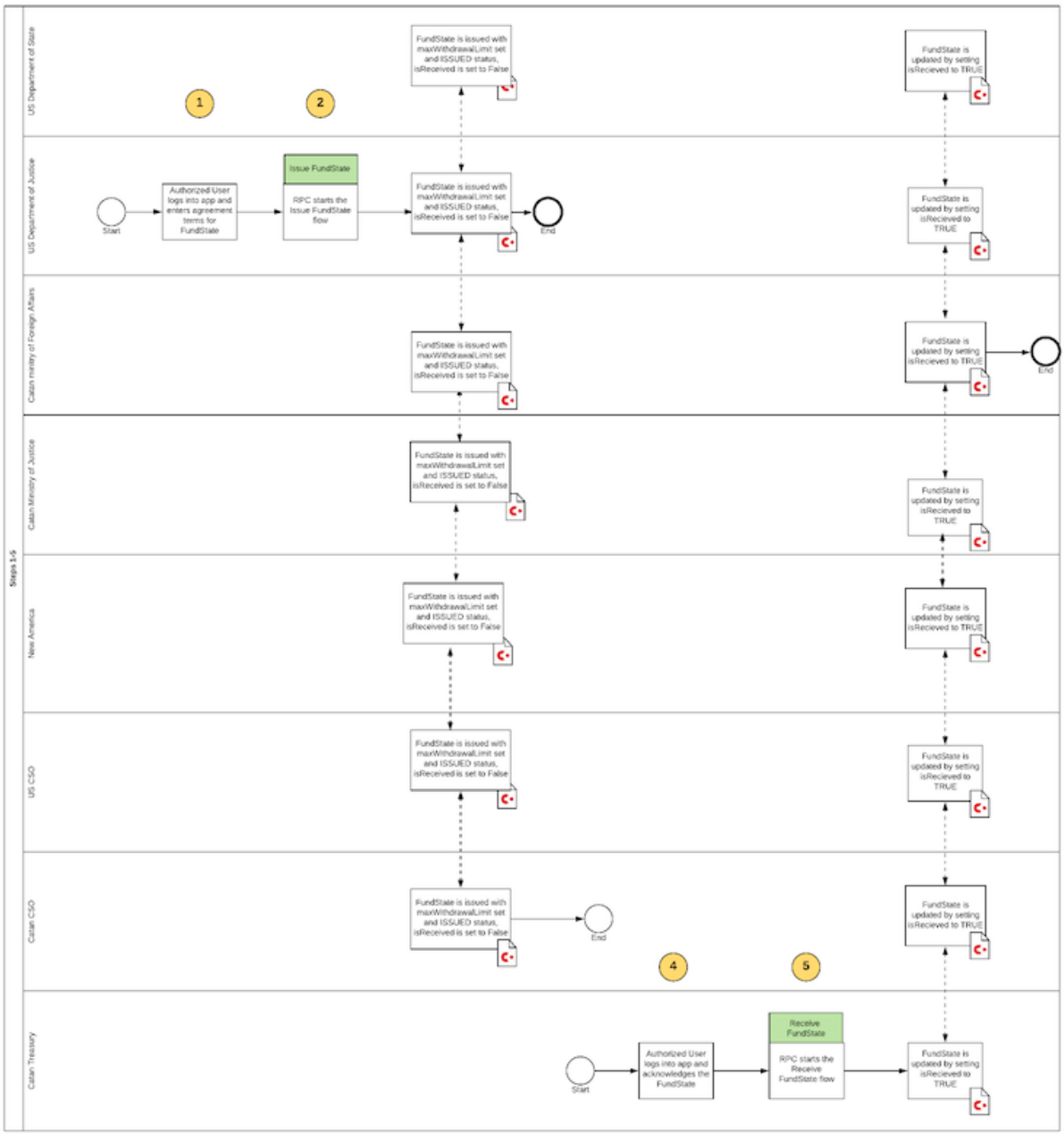
Approved agencies can see partial details of their transfer requests approved/rejected status. The authorized users will not see the username and if rejected, the reason for rejection also be withheld.

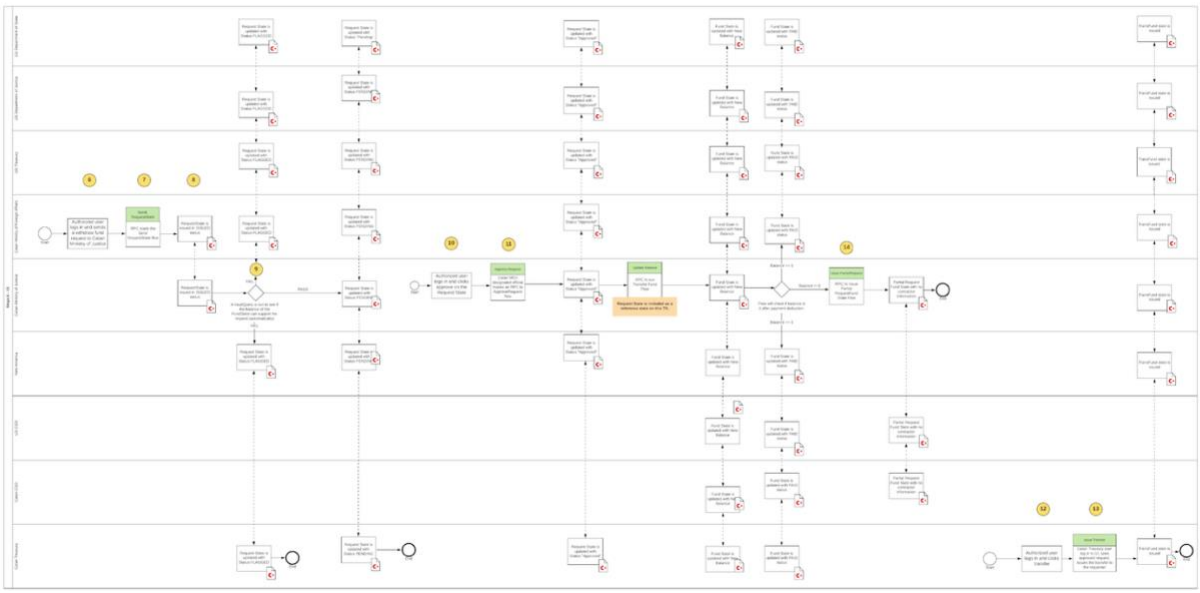
Step 13. A Catan Treasury user logs into the OARS and transfers the approved funds to the Catan Ministry of Education.

When transferred, optional configuration mail can be sent to Catan MoJ, Catan MoFA, and US DOJ, US State Dept can be implemented.

Step 14. A TransferFund state is issued on ledger.

Step 15. After the fund balance has been depleted, the Fund State status is set from "ISSUED" to "PAID".



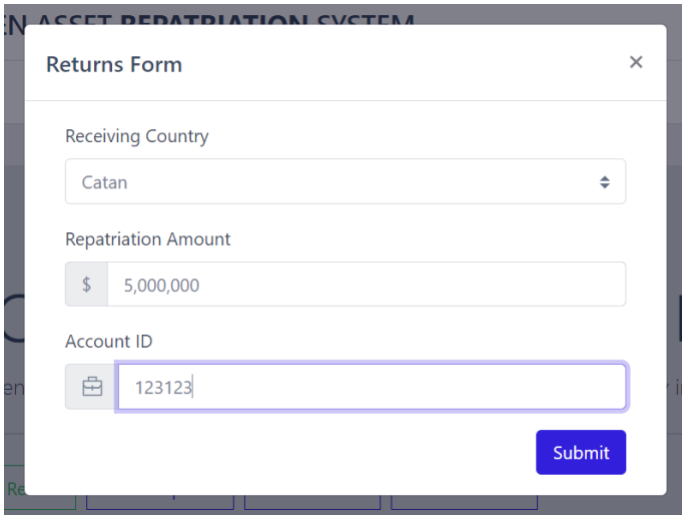


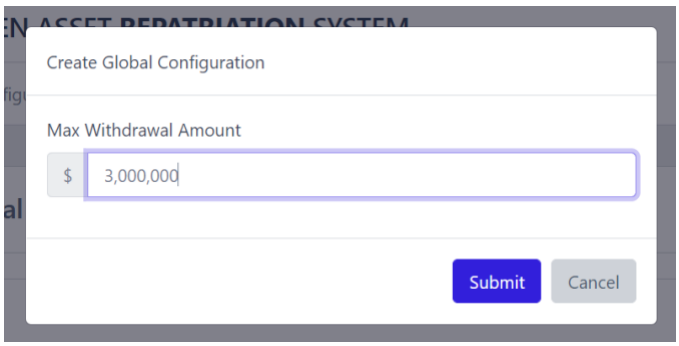
[Lucid Chart]

Scenario 1: Medium Transparency – OARS Related Screens

Step 1. U.S Treasury transfers the funds to Catan Treasury/Central bank.

Step 2. A user from the U.S Department of Justice will use OARS to enter the relevant information for the asset repatriated. A record will be created on the ledger with the recipient country, asset amount returned and the recipient country's destination account number for audit purposes. The U.S. DOJ will also set a maximum withdrawal limit for approved agencies. This is used to track potential irregular activity.





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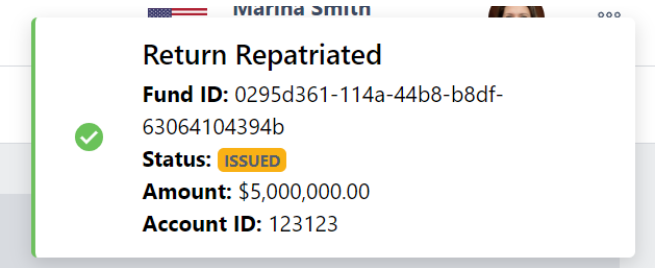
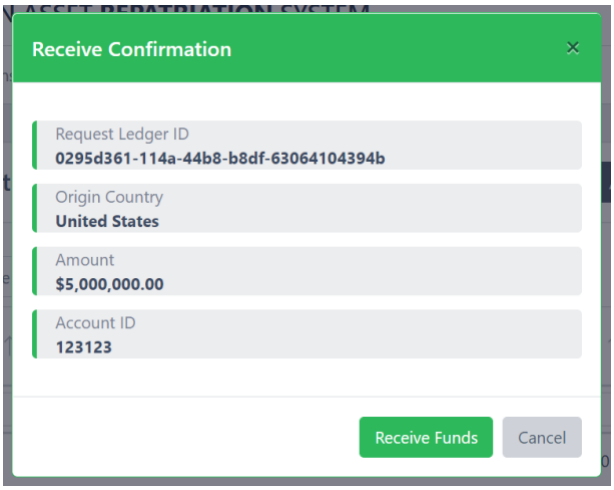
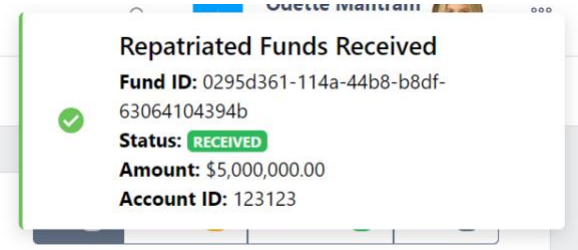


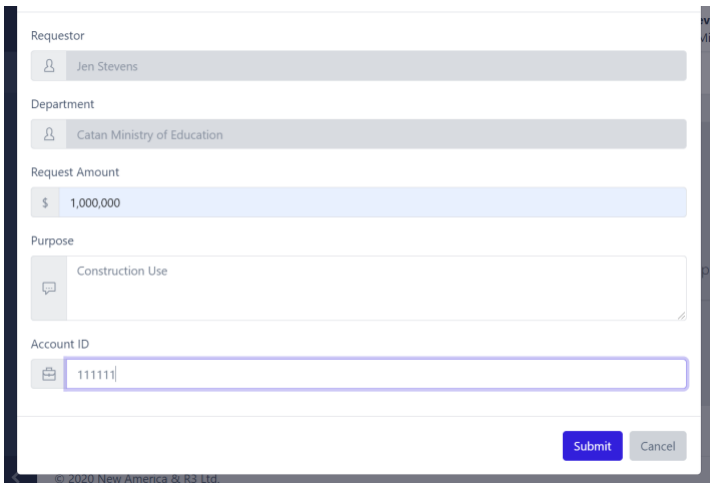
Step 4. A Catan Treasury user logs into OARS and acknowledges that s/he/they have received the funds.



Step 5. This kicks off a "Receive Fund" flow on Corda which sets the Received flag to TRUE.

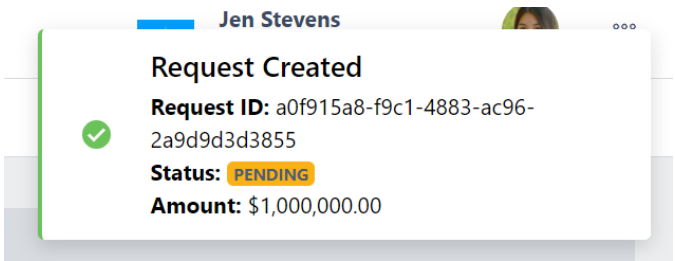


Step 6. An authorized user from an approved agency, such as Catan Ministry of Education[3] , can log into OARS and sends a transfer request to Catan Ministry of Justice. The authorized user will provide the requested amount, intended use of the money, and approved agency destination bank account number. Each request will indicate if the status is “PENDING” or “FLAGGED” for U.S. and Catan Government officials. Approved Agencies and CSOs will see all requests as “PENDING” prior to approval or rejection.

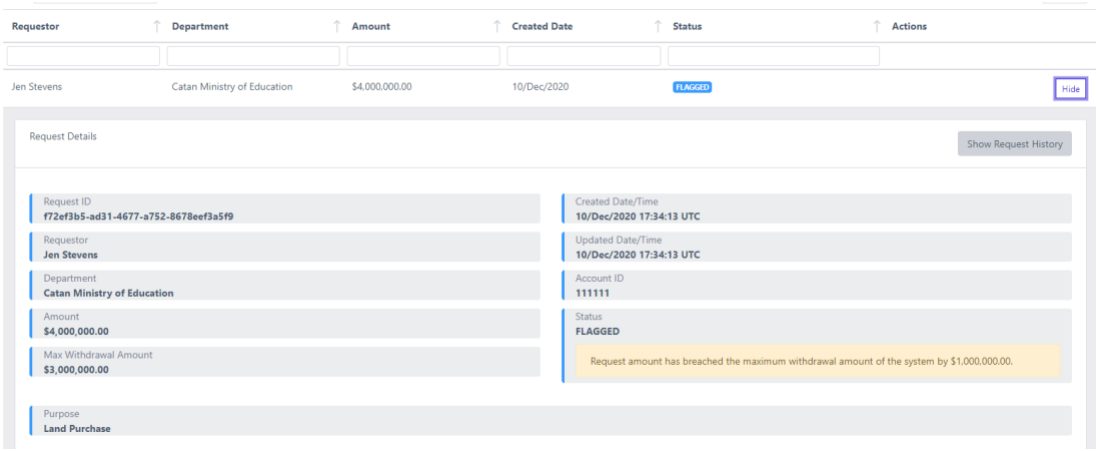


Step 7. This kicks off a "Send Request" flow on Corda which sends the RequestFund state to Catan Ministry of Justice.

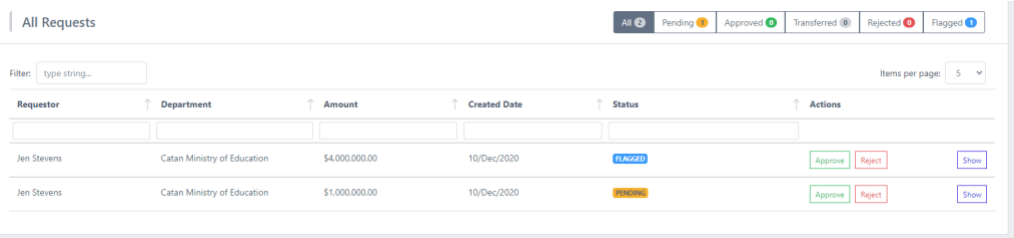
Step 8. A RequestFund state issued on ledger with "ISSUED" status.



Step 9. Corda checks the maximum withdrawal amount against the requested amount and marks requests that breaches the maximum withdrawal amount as "FLAGGED". Non flagged requests receive a status "PENDING".

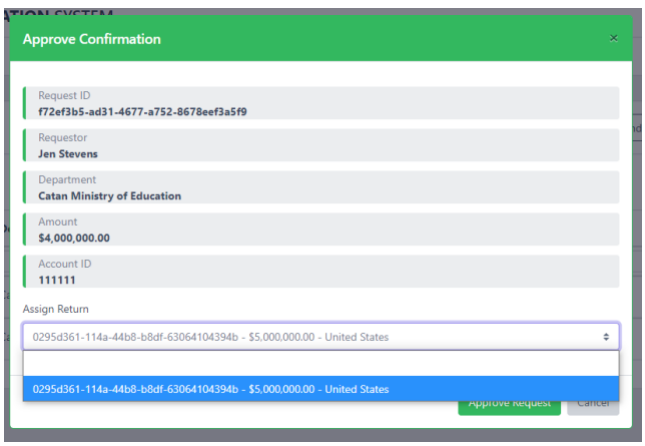


Step 10. A designated official can see all requests (flagged or not flagged) and can approve and sign off transfer requests in OARS. In scenario 1, the designated approver is on the recipient countryside. In this case, it is the Catan Ministry of Justice.

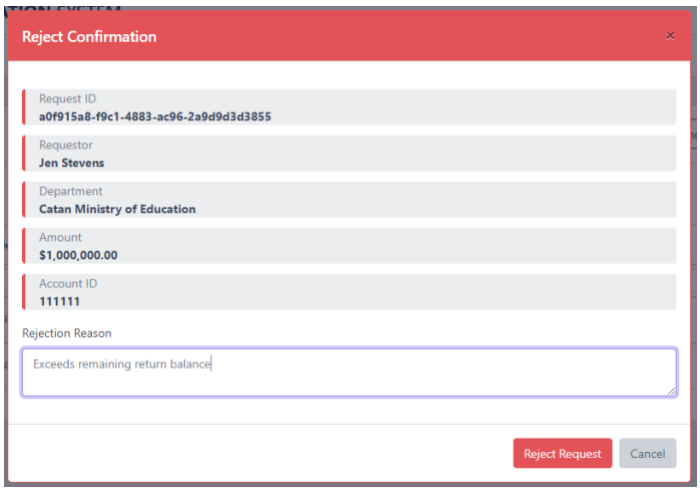


If Catan MoJ would like to approve a withdrawal request, s/he/they will link the withdrawal request to an asset return that has been entered in OARS.

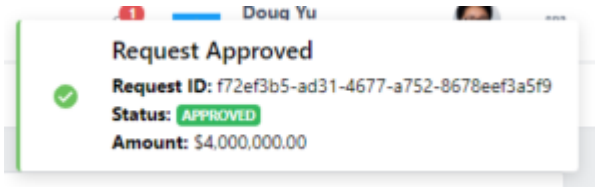
If the recipient country has multiple returns that have not been fully allocated to approved agencies, then the Catan MOJ user can assign any transfer requests from implementing agencies, such as Catan Ministry of Education to a particular asset return account. This would allow tracing the projects or spending allocated to a particular return.

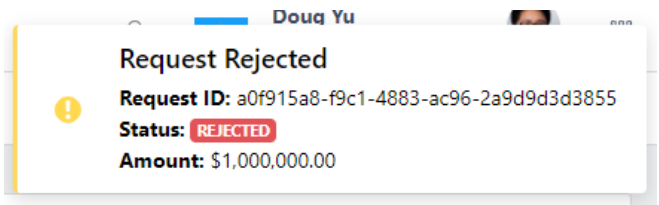


If Catan MoJ rejects a withdrawal request, the s/he/they will provide a reason for the rejection.

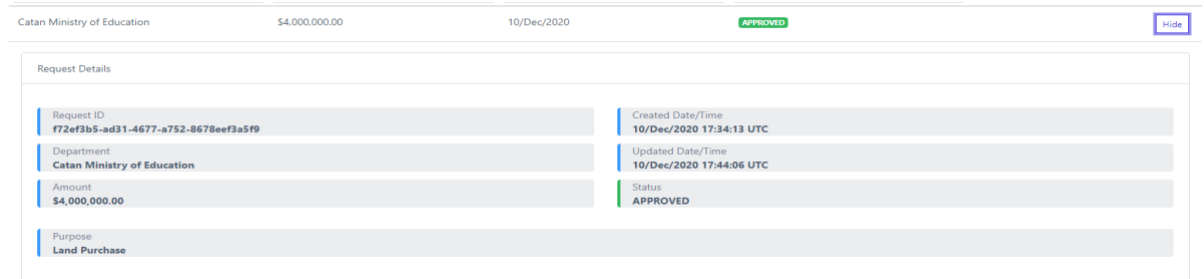


Step 11. Upon approval and fund matching, the status of RequestFund state changes from "PENDING" to "APPROVED" in case of approval. A successful run of the "Update Balance" flow will produce an updated Fund State after approval of the request with the new balance and a PartialRequestFund state in OARS.

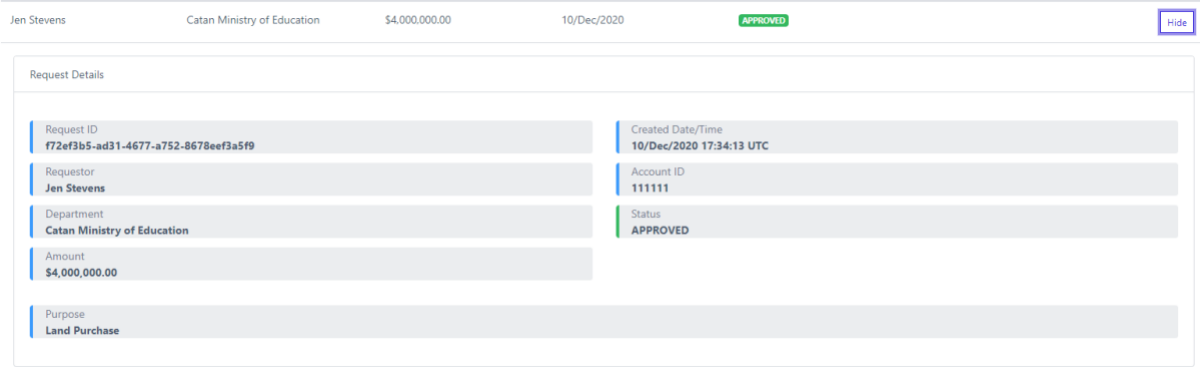




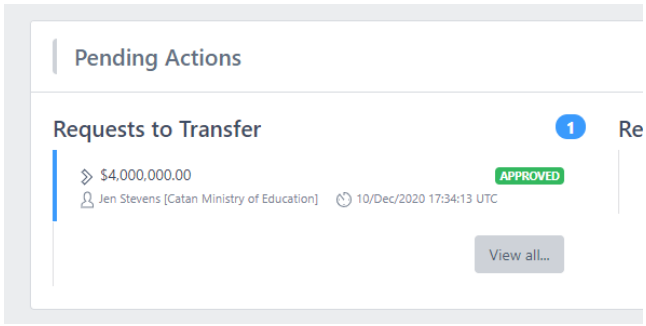
Step 12. U.S CSO and Catan CSO can see a partial details of approved agency transfer requests without the username, bank account details, and rejection details.

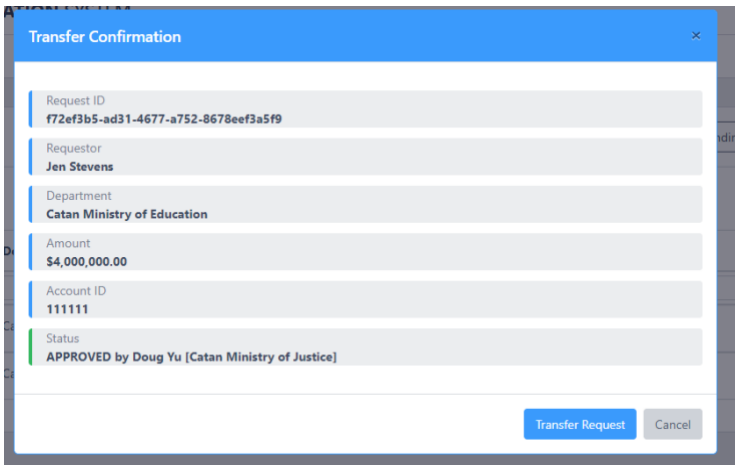


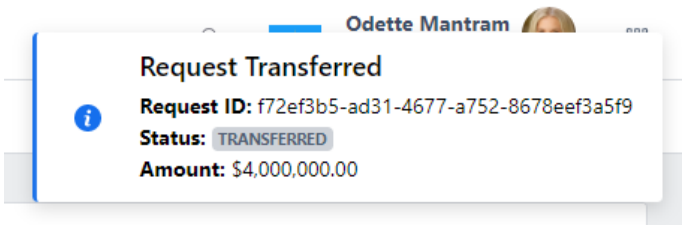
Approved agencies can see partial details of their transfer requests approved/rejected status. The authorized users will not see the username and if rejected, the reason for rejection also be withheld.



Step 13. A Catan Treasury user logs into the OARS and transfers the approved funds to the Catan Ministry of Education.







Cordapp CDL

In conjunction with Business Process Modeling Notation (BPMN), Cordapp CDL (a bespoke Cordapp design language that accurately represents Cordapp design) shows the potential state construction and how data is allocated and consumed by different actors on ledger.

Scenario 1: Medium Transparency

U.S Department of Justice creates the Fund State and sets the maximum withdrawal amount on the Fund State. The *"owners"* field on this state (see definition below) is used later in the smart contract to prevent malicious use of the Fund State. The *"requiredSigners"* field on this state represents the parties or nodes that need to sign future changes to the Fund State – it can be the same parties or different parties from *owners*.

A Word on Owners and RequiredSigners

Owners – a list of users who can change the attributes of the Fund state (essentially initialize and/or later update the terms of the off-ledger agreement) such as maxWithdrawalAmount.

requiredSigners – a list of users who are required to sign off on each RequestFund state.

The above two lists provide the users of the CorDapp with a configurable set of permissions for who can set the terms and who is required to sign off for every request for funds.

Example 1 (Scenario 1):
The agreement between the U.S. and Catan might require that the U.S. is the only one able to set the terms of the Fund state AND Catan doesn't want to give the U.S. the privilege to sign off on any Request states. The lists would then be populated as:

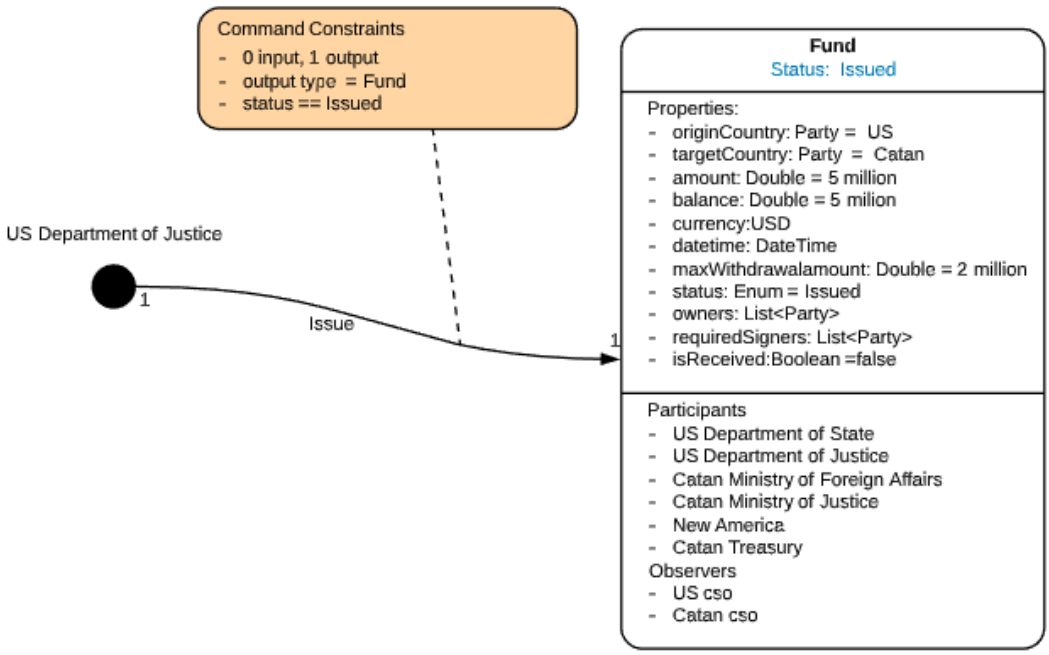
owners = [United States]
requiredSigners = [Catan]

Example 2 (Scenario2):
The agreement between the U.S. and Catan might require that the U.S. and Catan have the ability to set or update the terms of the Fund state AND Catan does have the political will to give the U.S. signing rights. The lists would then be populated as:

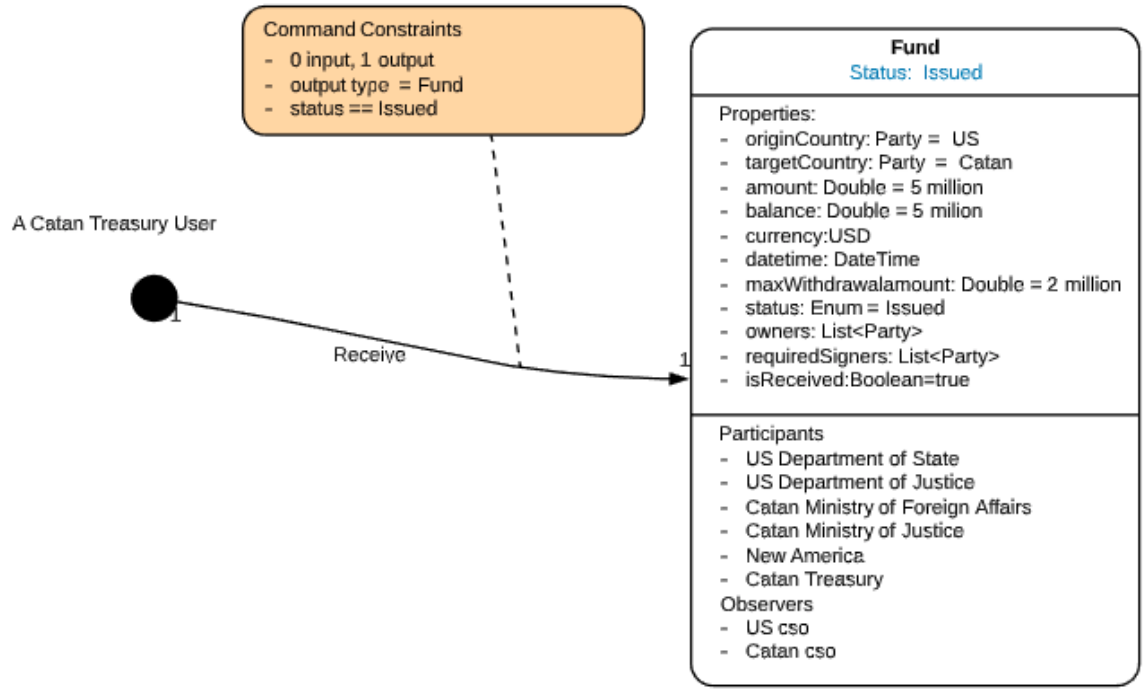
owners = [Unites States, Catan]

requiredSigners = [United States, Catan]

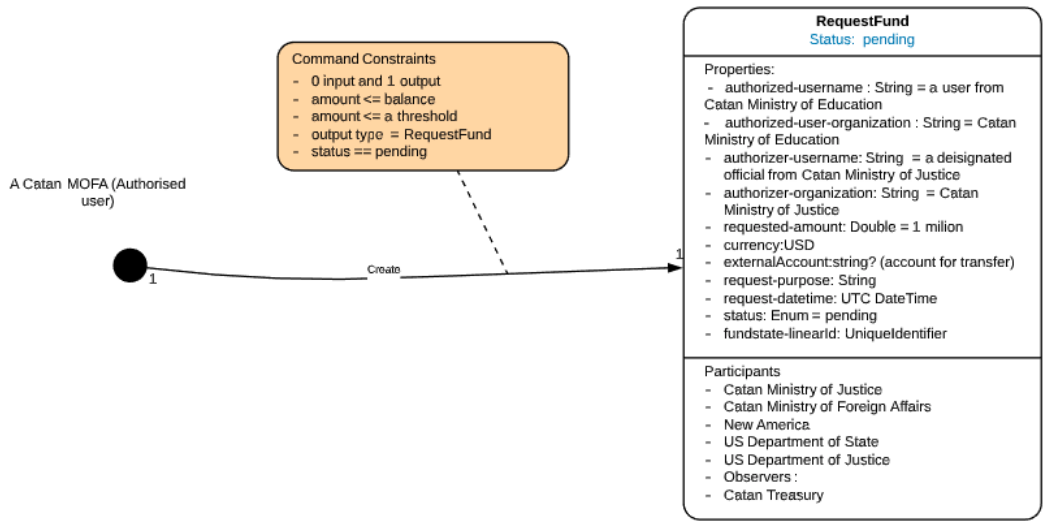
With this level of flexibility, the CorDapp can handle both scenario 1 & 2 using the same architecture while the smart contract ensures that only the respective parties in the lists can run certain functions.



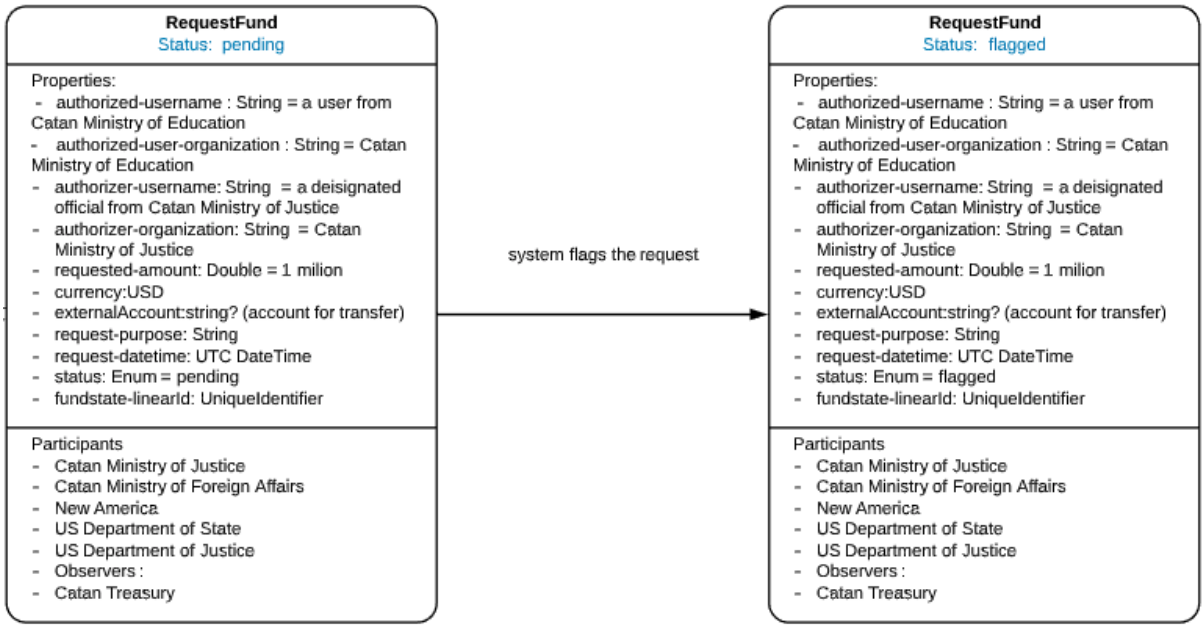
A Catan Treasury user acknowledges receiving the funds, thus changing the Received Boolean from FALSE to TRUE.



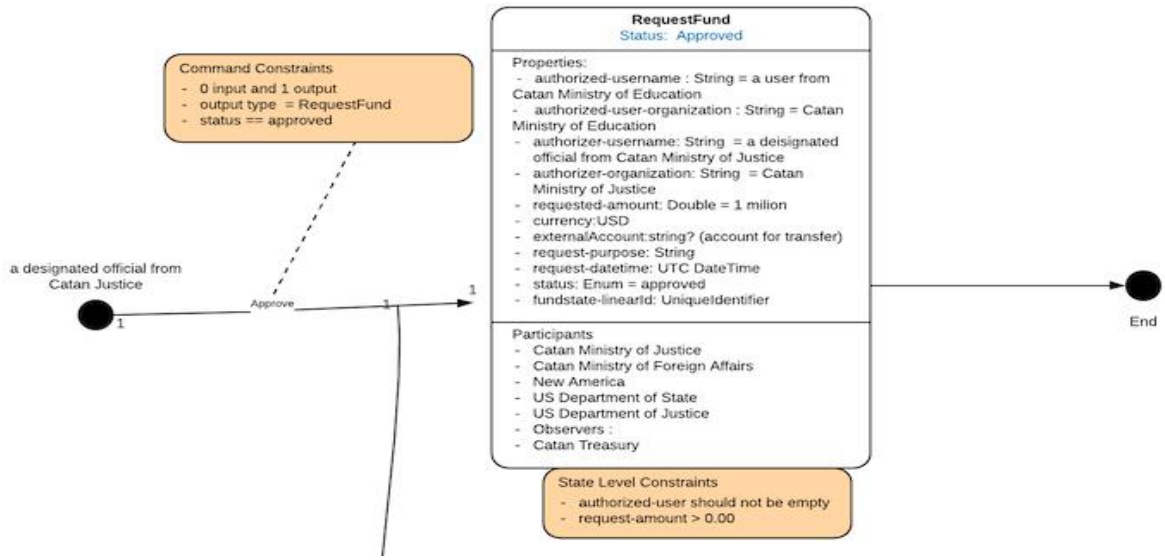
An authorized user from Catan Ministry of Education sends a request to Catan Department of Justice, which results in a RequestFund state on ledger. The RequestFund state represents a request for funds on ledger. The RequestFund state contains a reference to the Fund state and uses the *requiredSigners* from the Fund state for signing off the approval transaction.



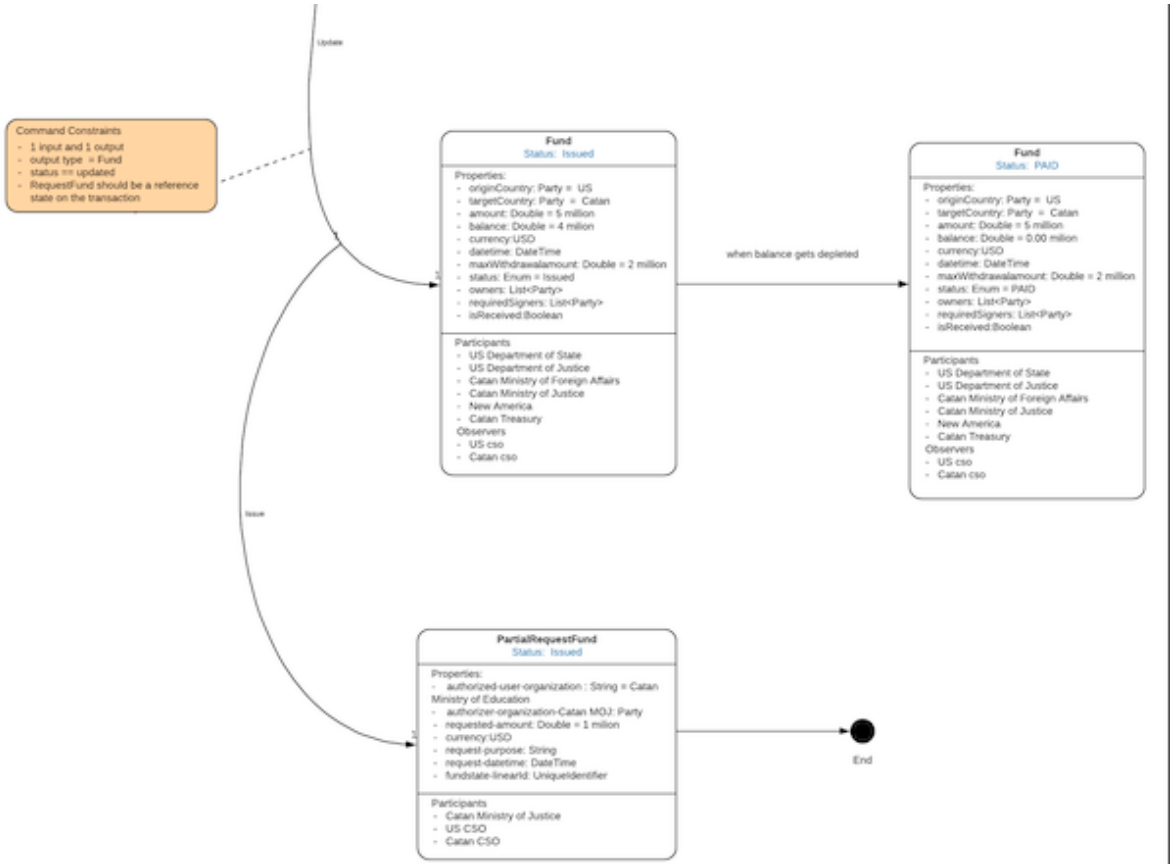
Corda flags any requests in the system if the requested amount is higher than the balance or is higher than the maximum withdrawal amount.



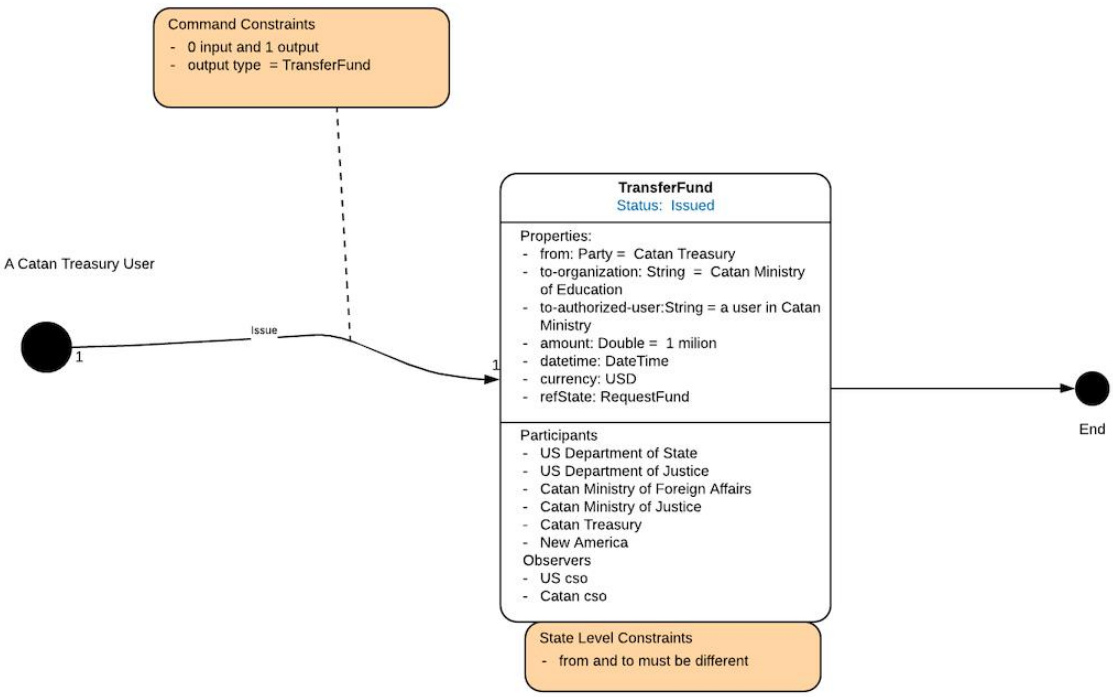
After the request has been approved by a designated official from Catan Ministry of Justice and signed off by *requiredSigners* in the Fund state, the Fund balance gets updated to the new amount, and the record of withdrawal gets shared with U.S. Department of State, U.S Department of Justice, Catan Ministry of Foreign Affairs, Catan Ministry of Justice, Catan Treasury and New America. A partial record of withdrawal gets shared with U.S. CSO and Catan CSO (CSOs do not see the name of the user). After that, Catan Treasury transfers the requested fund to the authorized user.



After repatriated funds have been sent to Catan and the approved funds have been fully withdrawn, the Fund state status changes from ISSUED to PAID.



The Catan Treasury transfers the requested amount of fund to the authorized user. TransferFund state contains a reference to the approved request for tracking purpose.

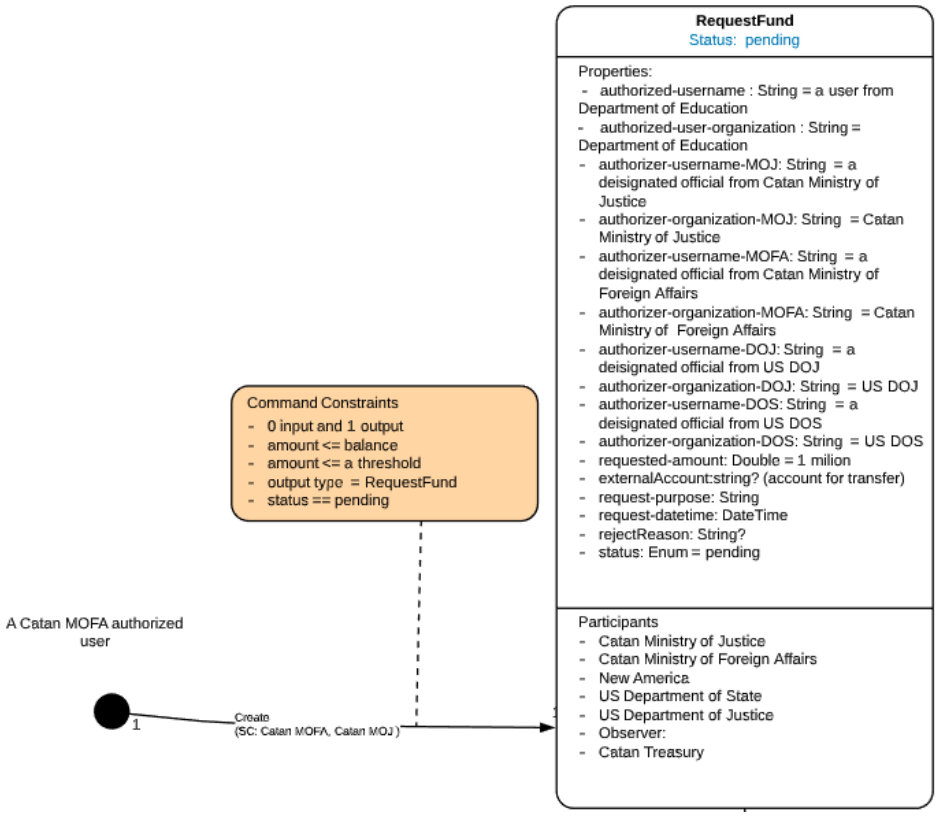


[Lucid Chart]

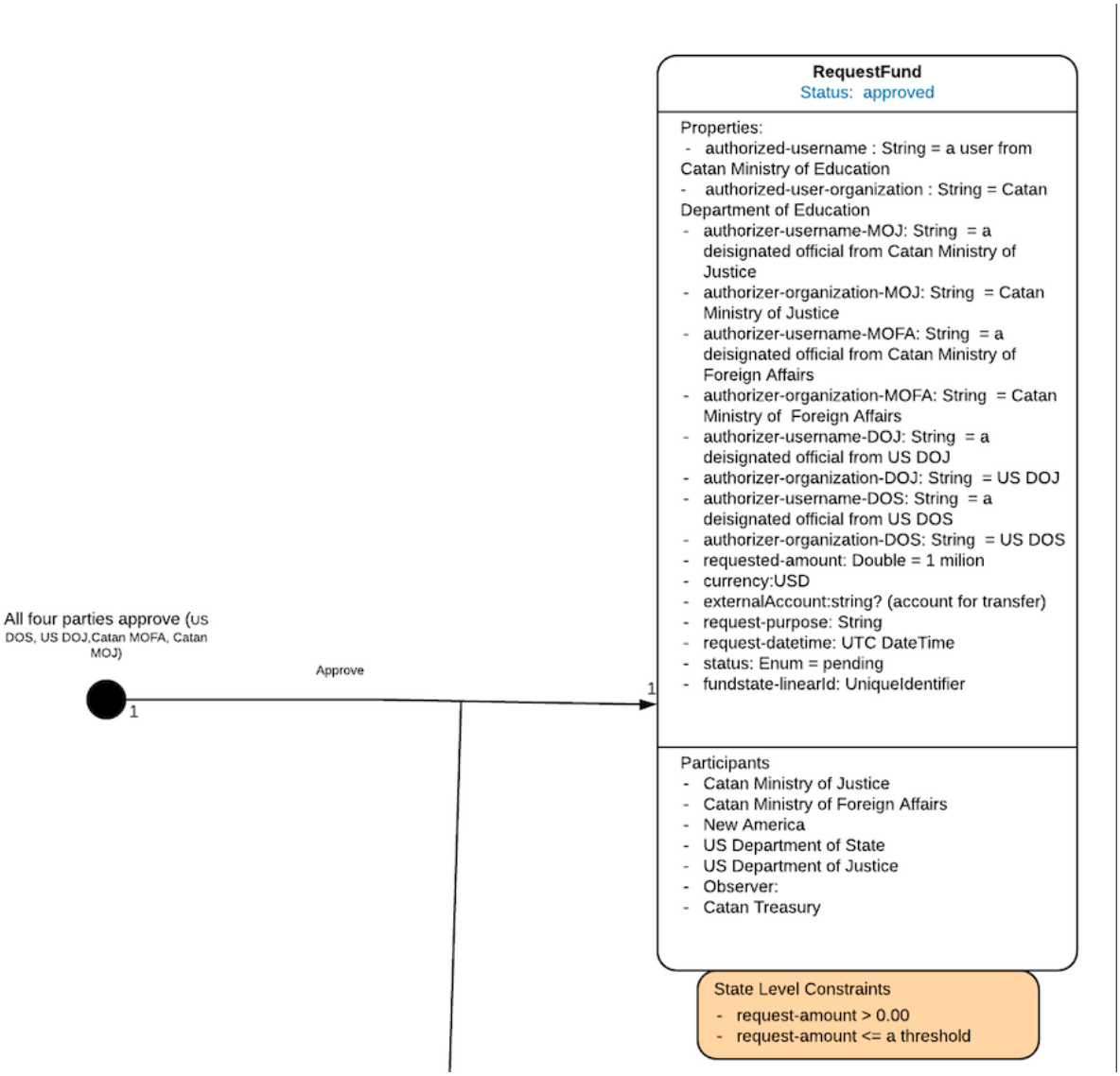
Scenario 2: High Transparency

Under this scenario, four parties - the U.S. Department of State, U.S. Department of Justice, Catan Ministry of Foreign Affairs and Catan Ministry of Justice - need to authorize the withdrawal request for the repatriated funds. Only when a request gets approved and signed by all four parties is the request is considered finally approved for withdrawal. The issuance and receiving workflows of the Fund state are the same as Scenario 2.

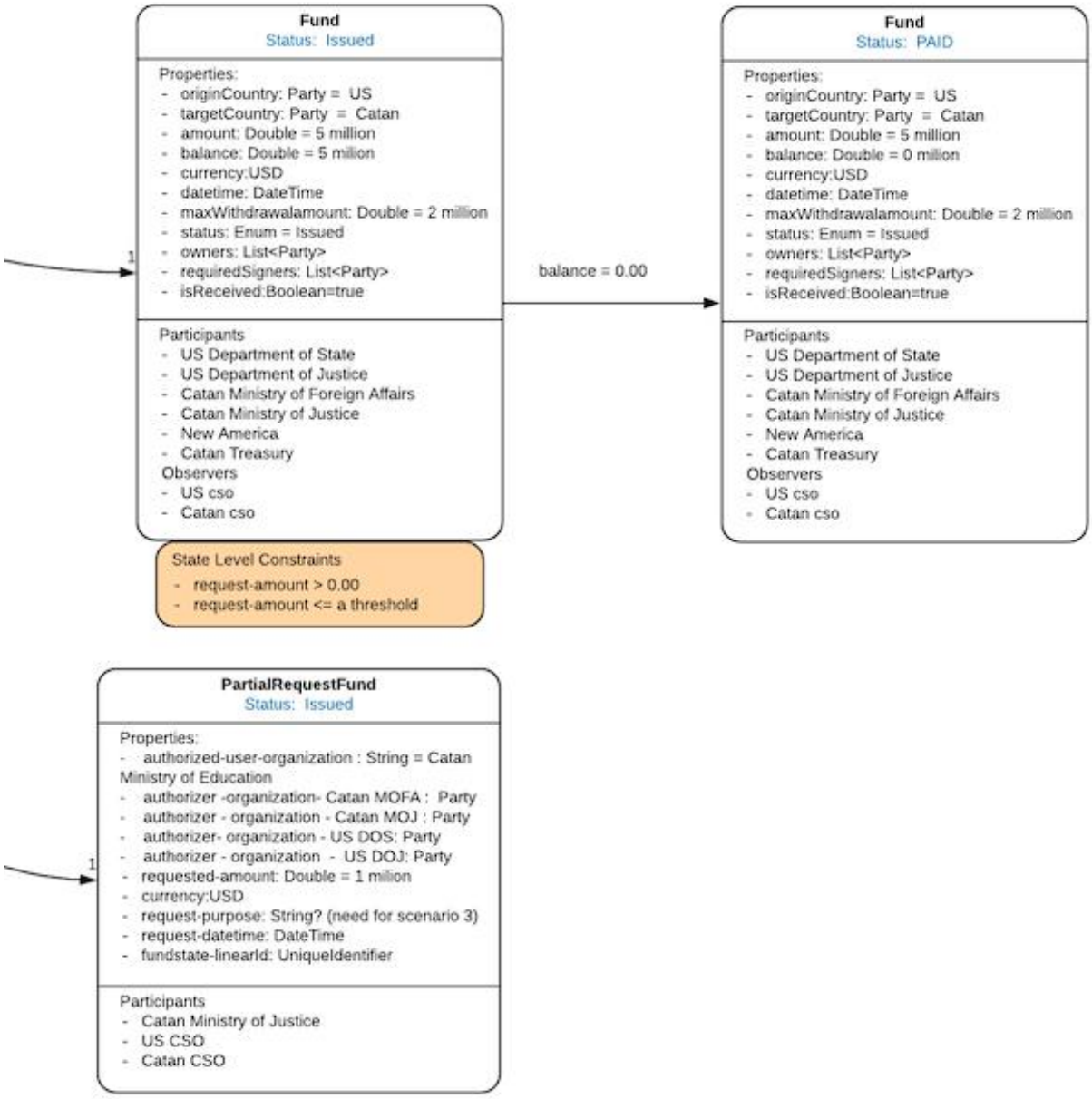
There are more fields added on RequestFund state to represent officials and their departments from both the U.S. side and Catan side. When an authorized user from Catan Ministry of Foreign Affairs sends a withdrawal request, the request data gets stored on ledger as a RequestFund state.



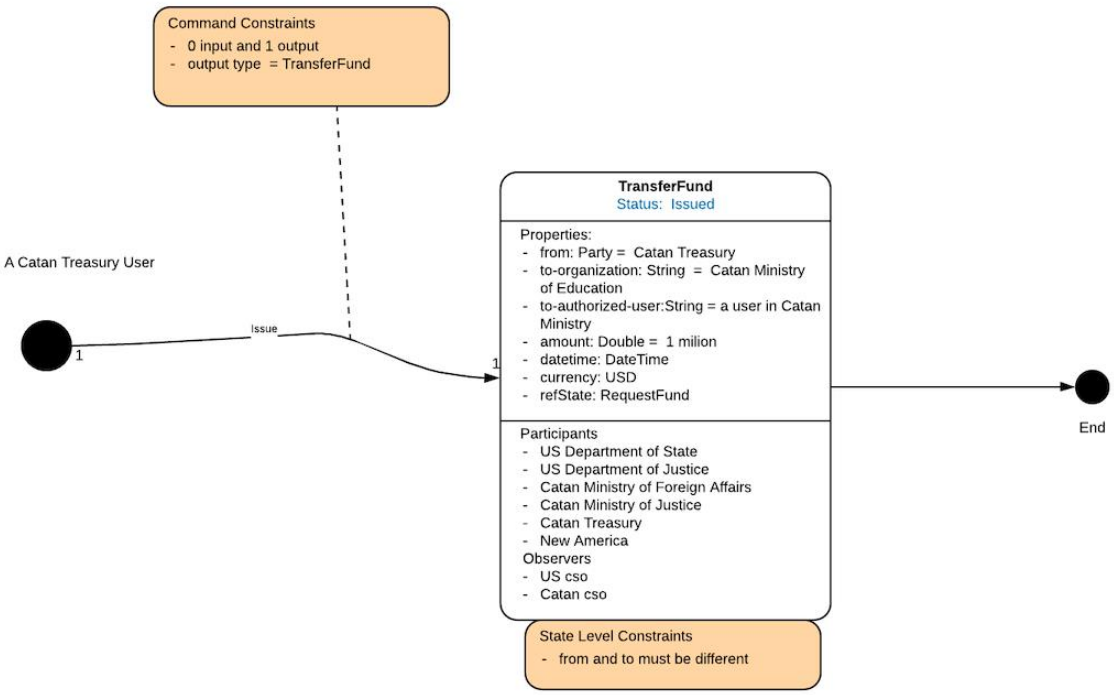
The request status changes to approved when the request gets approved and signed by all four parties.



After the request has been approved, the Fund state balance gets updated to the new balance. The record of withdrawal gets shared with U.S. Department of State, U.S Department of Justice, Catan Ministry of Foreign Affairs, Catan Ministry of Justice and Catan Treasury. A partial record of withdrawal gets shared with U.S. CSO and Catan CSO.



Catan Treasury then transfers the requested amount of funds to the authorized user, which results in a TransferFund state on ledger. TransferFund state represents a transfer record that contains a reference to the approved request for tracking purpose.



[Lucid Chart]

Network Design Options

The business network choice is a decision for New America based on the selection of a target country. R3 provides different network options for different client situations. Today, business network operators using Corda have three network options to choose from[4]:

1. Corda Network

Corda Network is a shared, permissioned, global network, publicly available, which business networks may join and operate within. It is governed by a not-for-profit Foundation in the Netherlands, which sets network policies for all participants e.g. around identity checking and security, pricing, and network parameter upgrades and monitors the Network Operator (currently R3). Business network operators may use the Corda Network-provided notary or operate their own. They also have access to use the Corda Network pre-production (UAT) test environment.

2. Segregated Network

A Segregated network is a partitioned sub-network within the Corda Network, which enables membership privacy (only members of the segregated network are visible to each other) and control over its software upgrade schedule. The segregated network is therefore governed by the Corda Network Foundation, in conjunction with the business network operator. The business network operator will operate their notary (either run by themselves or a third party). The segregated network may merge with Corda Network at a time of the business network operator's choosing.

3. Private Network

A Private Network can take different forms, but would be set-up, operated, and governed by the business network operator or a third party. This allows the business network operator to retain complete control, making decisions on policies including whether it uses / issues certificates, whether it uses the internet/runs on an internal network, the location of infrastructure and services, as well as its software upgrade schedule. The private network will need to run its network services, including a notary, and would need a trusted root – either set up its own or outsource to a third party.

[4] R3 is currently exploring alternative network options beyond the three listed in this document. The goal of this alternative is to deploy Corda economically and centralize the deployment on one machine. Further information will be provided to New America once R3 have confirmed plans.

OARS is built on a mock/bootstrapped network. The network choice should be made after country selection by New America.

A Word on Notary

A notary (cluster) in Corda is a network service that provides uniqueness consensus by attesting that, for a given transaction, it has not already signed other transactions that consume any of the proposed transactions input states (prevents "double-spends").

There are two types of notaries in Corda: validating and non-validating. A validating notary co-signs new receipts, per the notary function above but, additionally, attests that the chain of data, receipts and business logic processed to date are self-consistent and that, to the extent recipients trust the validating notary, they no longer need to ask for transaction histories in order to validate transactions for themselves. The non-validating mode has the advantage of completely preserving transaction privacy – only the state references, timestamp and the notary party is revealed. The final choice of the notary depends on the business network-level requirements. There are privacy considerations that should be agreed between the U.S. government and the selected country. The network choices are explained in the section above[5]. For this PoC, R3 will be using a non-validating notary which uses a reference to the transactions for security purpose. The content of the full content of the transaction will not be widely shared to the notary. Notary options can be configured based on agreement between the two countries.

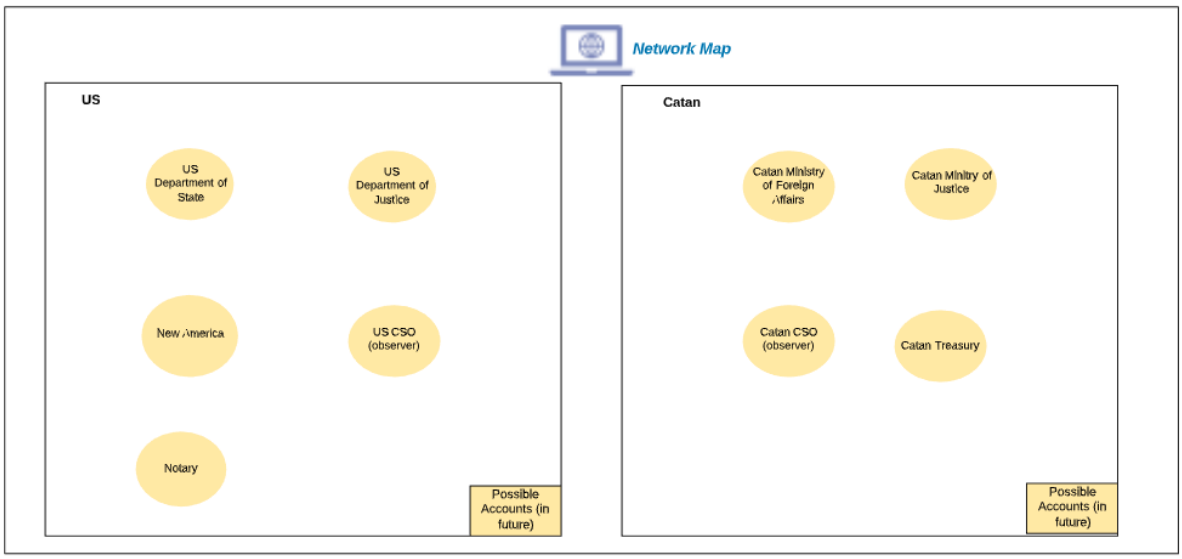
There are five Corda nodes on the U.S. side: U.S. Department of State, U.S. Department of Justice, U.S. CSO (observer node), New America, and a non-validating notary.

There are four Corda nodes on the Catan side: Catan Approved Agency, Catan Ministry of Justice, Catan Treasury and Catan CSO (observer node).

For this PoC, each node in the following diagram uses a default network-level node identity and can identify each other using a network map configuration. However, all eight nodes can host multiple accounts and add application-level user management in the future to meet the need of multiple users, such as different regional bureau users of the U.S. Department of State.

[5] See "Network Design Options
"

Bootstrapped Network (PoC)

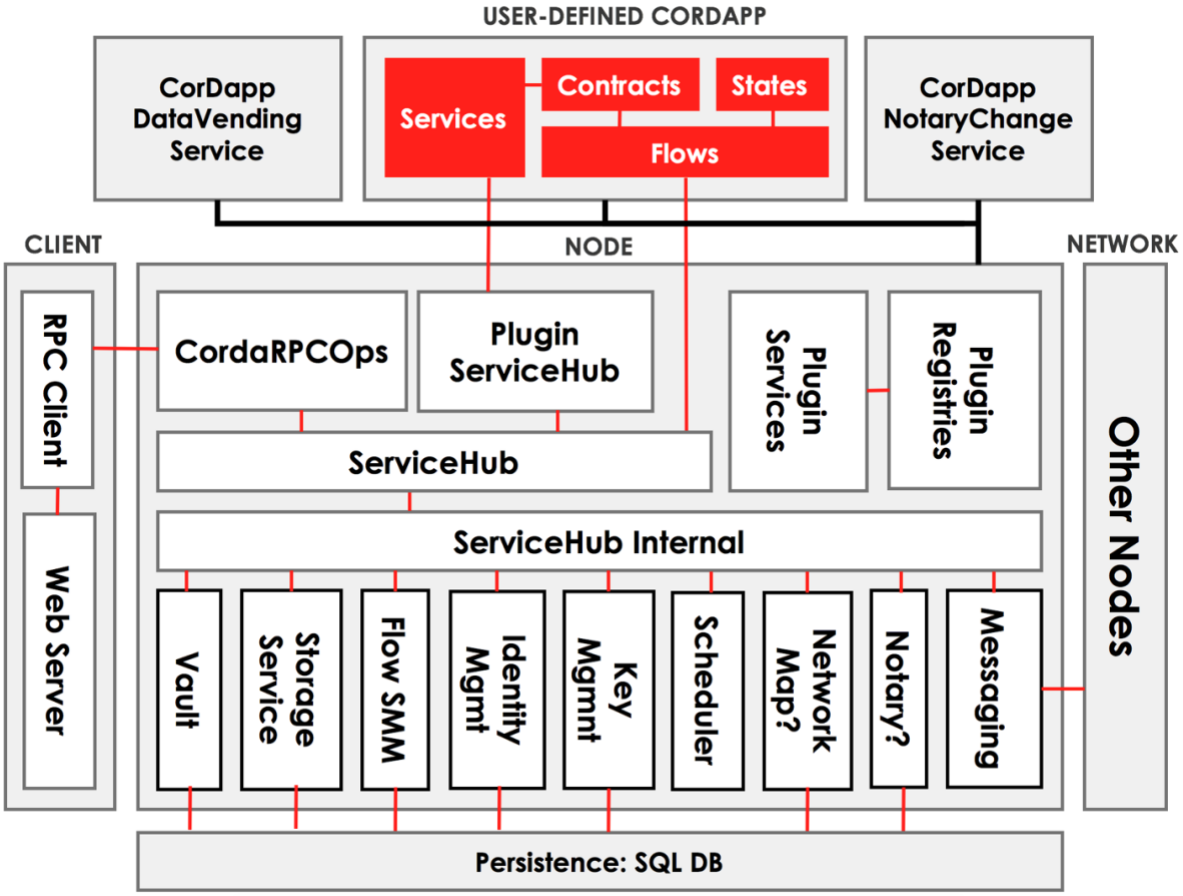


[Lucid Chart]

Application Architecture

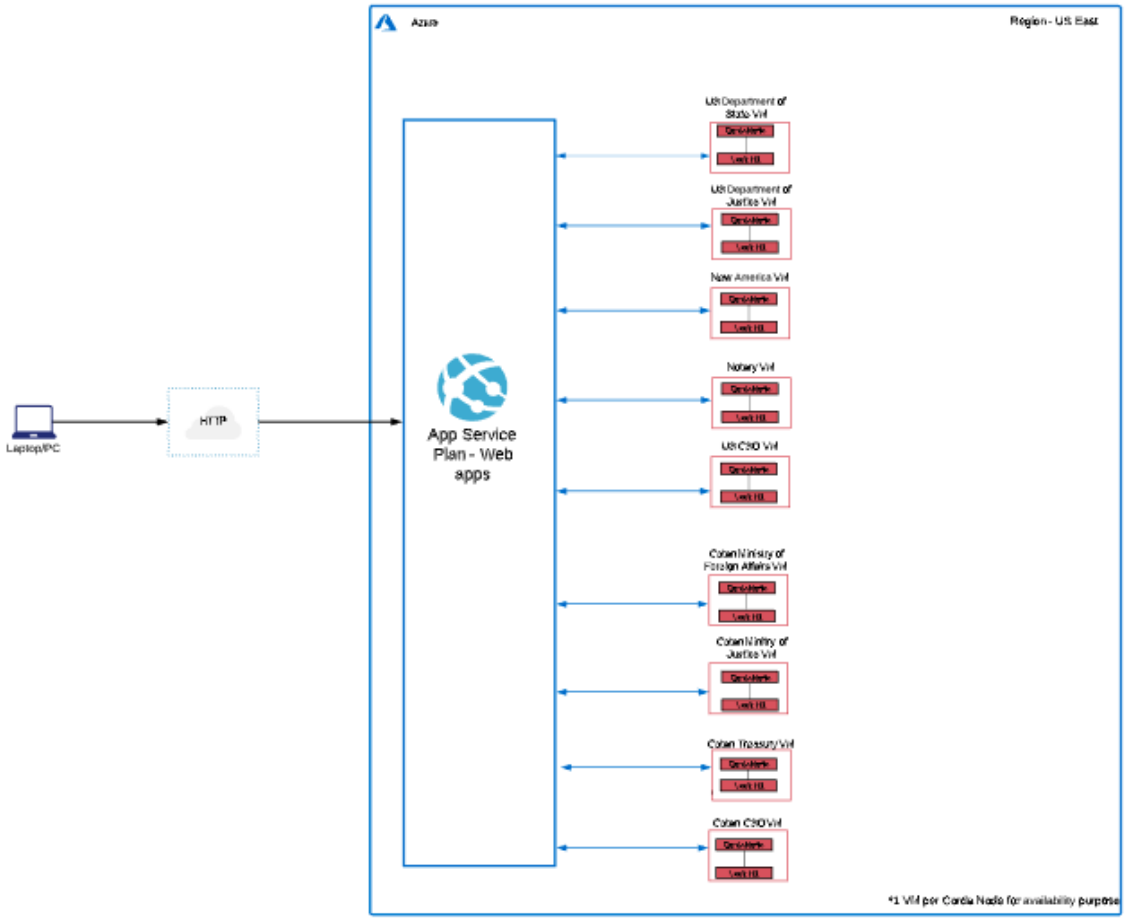
The target application is going to be created during the embedded development phase. R3 team will commit code and relevant documentation of features directly into a public GitHub repository set up by New America. The first diagram in this section demonstrates the internal architecture of a Corda node. The second diagram shows the architecture of New America PoC Cordapp deployment.

Node Architecture



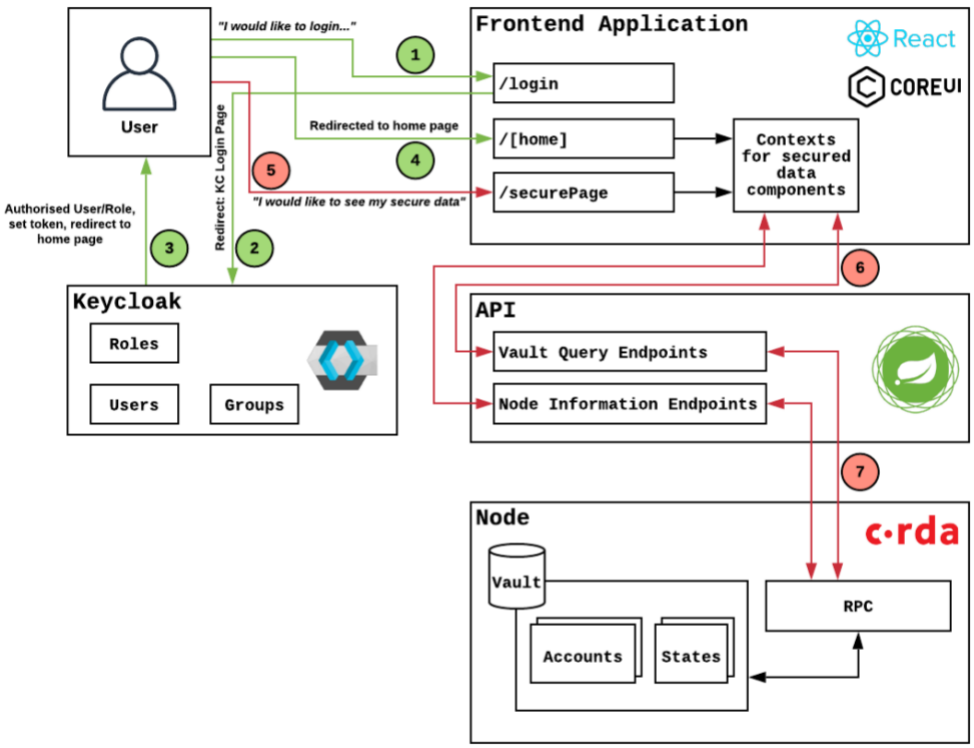
Deployment Architecture

R3 will use Azure Cloud Service to deploy New America Cordapp to meet the requirements of PoC while not compromising flexibility and efficiency of future deployments. There are nine nodes in this deployment diagram: U.S. Department of State, U.S. Department of Justice, New America, U.S. CSO, Notary, Catan Ministry of Foreign Affairs, Catan Ministry of Justice and Catan CSO. Each node will be hosted on one Azure Virtual Machine for availability consideration. In the initial deployment, R3 is going to use US East as the only hosting region. New America has the flexibility to use more country-specific and more resilient deployment strategies in the future. For example, deploying to a region closer to the target country, replicating data in another zone etc.



Lucid Chart

The detailed web application flow looks like below. R3 is going to use Keycloak for user authentication and management to facilitate different UI views of different users. The more detailed usage of Keycloak will be submitted into the GitHub in a README.md file.



Project Scope and Future Milestones

Project Scope

The scope of this engagement is to develop a full-stack application called OARS supporting the workflow of asset repatriation to a recipient country from the United States. The prototype will support the workflow of the following actors where assets are repatriated in Scenario 1 (Medium Transparency):

- US Dept of Justice
- US Dept of State
- Catan Ministry of Justice
- Catan Approved Agency
- Catan Treasury
- Catan CSO
- US CSO
- Administrator

By project end, the goal of the PoC is to have a working application that will be demonstrated to the U.S. Department of Justice and U.S. Department of State.

We de-prioritized the following areas from the current project scope:

- Exchange Rate

  This POC uses the U.S. dollar as the currency for both the U.S and Catan. It would be a consideration in the future to display currency in local currency for the selected country.

- Interest Rate

  In a real-life scenario, when the repatriated funds sit in Catan Treasury/Central bank, some interest could be accrued over time. Fund state could include the interest rate in the future to reflect this fact.

- Operational Fees

  There's potential transaction cost to repatriate fund from U.S. Treasury to Catan Treasury, which results in a different amount than received by Catan

Treasury. See Appendix A for cost calculation of a Corda application deployment.

- Language Translation

  This PoC uses English for user interface display both on the U.S. side and Catan side. Language translation could be nice to have featured in the future for end-users in Catan.

- Currency

  This PoC uses USD on both the U.S side and Catan side. However, the current design allows for an easy switch to another currency using the *currency* attribute on respective states.

- Maximum Withdrawal Limit

  R3 came up with this term as one of the possible criteria to detect fraudulent requests. New America, in conjunction with the U.S. Department of State and U.S. Department of Justice could use different criteria or implement a different mechanism for the same purpose in future development.

- Permission Terminated

  The network-level permission is baked into the current technical design for Scenario 2 and Scenario 3. This allows easy management of network-level identities, such as U.S Department of State and U.S Department of Justice. The *owners* of the Fund state can make changes to the Fund state and the *requiredSigners* of the Fund state must sign approved requests. Both attributes can be amended to allow easy addition or removal of the network-level identities and signatures. For user-level authentication and authorization of OARS, such as Alice Bob from Catan Ministry of Education, R3 uses keycloak, an open source identity and management tool. New America has the flexibility to use a different user management system in the future.

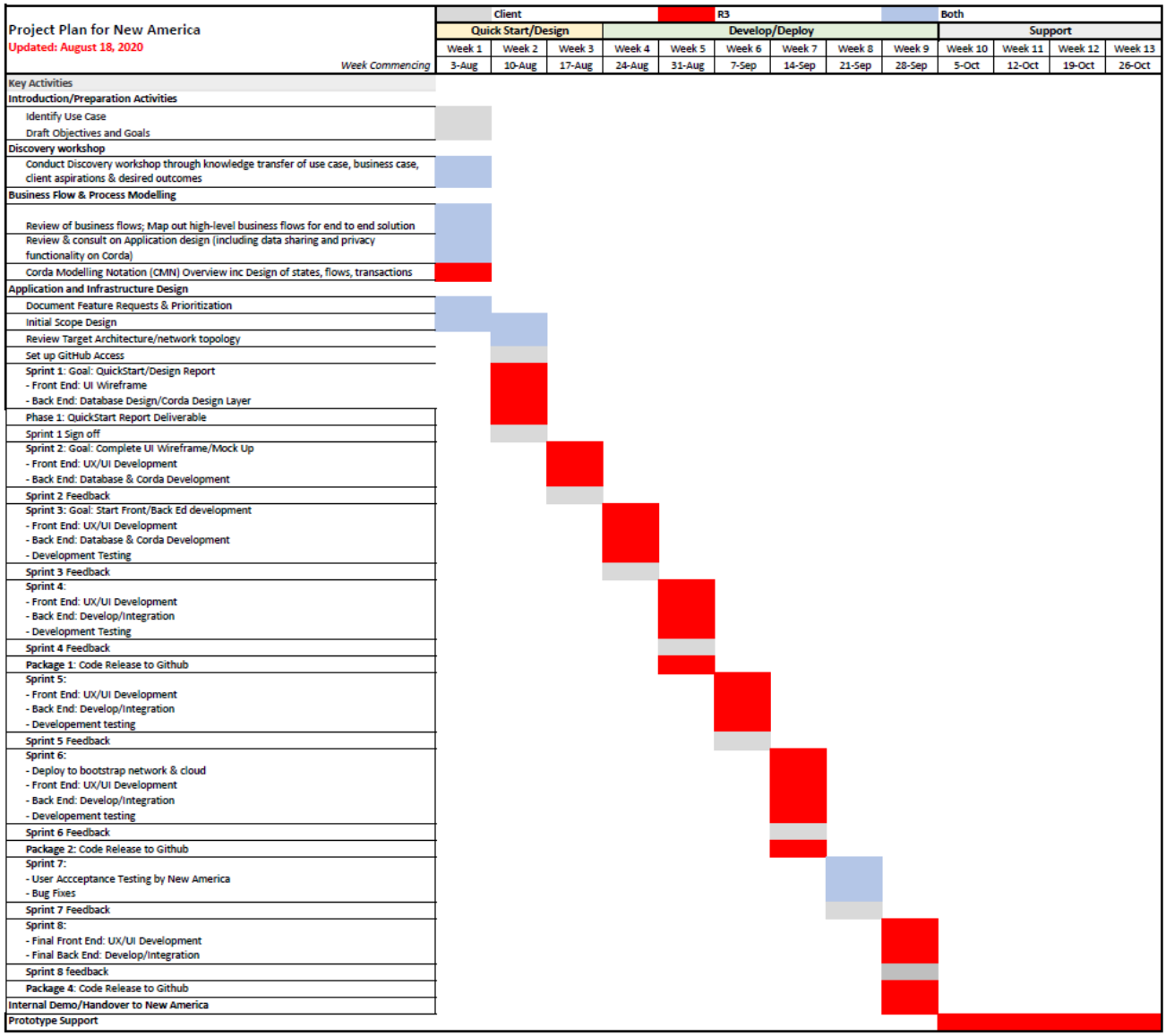
Project Milestones

Phase 1: Quick Start/Design: 3 weeks

Phase 2: Develop & Deploy: 6 weeks

Phase 3: Prototype Support: 4 weeks

Project Development Plan



Project Plan for New America Updated: August 18, 2020	Client	R3	Both
	Quick Start/Design	Develop/Deploy	Support
Week Commencing	Week 1 (3-Aug)	Week 2 (10-Aug)	Week 3 (17-Aug)	Week 4 (24-Aug)	Week 5 (31-Aug)	Week 6 (7-Sep)	Week 7 (14-Sep)	Week 8 (21-Sep)	Week 9 (28-Sep)	Week 10 (5-Oct)	Week 11 (12-Oct)	Week 12 (19-Oct)	Week 13 (26-Oct)
Key Activities													
Introduction/Preparation Activities													
Identify Use Case Draft Objectives and Goals													
Discovery workshop													
Conduct Discovery workshop through knowledge transfer of use case, business case, client aspirations & desired outcomes													
Business Flow & Process Modelling													
Review of business flows; Map out high-level business flows for end to end solution													
Review & consult on Application design (including data sharing and privacy functionality on Corda)													
Corda Modelling Notation (CMN) Overview inc Design of states, flows, transactions													
Application and Infrastructure Design													
Document Feature Requests & Prioritization													
Initial Scope Design													
Review Target Architecture/network topology													
Set up GitHub Access													
Sprint 1: Goal: QuickStart/Design Report - Front End: UI Wireframe - Back End: Database Design/Corda Design Layer													
Phase 1: QuickStart Report Deliverable													
Sprint 1 Sign off													
Sprint 2: Goal: Complete UI Wireframe/Mock Up - Front End: UX/UI Development - Back End: Database & Corda Development													
Sprint 2 Feedback													
Sprint 3: Goal: Start Front/Back Ed development - Front End: UX/UI Development - Back End: Database & Corda Development - Development Testing													
Sprint 3 Feedback													
Sprint 4: - Front End: UX/UI Development - Back End: Develop/Integration - Development Testing													
Sprint 4 Feedback													
Package 1: Code Release to Github													
Sprint 5: - Front End: UX/UI Development - Back End: Develop/Integration - Developement testing													
Sprint 5 Feedback													
Sprint 6: - Deploy to bootstrap network & cloud - Front End: UX/UI Development - Back End: Develop/Integration - Developement testing													
Sprint 6 Feedback													
Package 2: Code Release to Github													
Sprint 7: - User Accceptance Testing by New America - Bug Fixes													
Sprint 7 Feedback													
Sprint 8: - Final Front End: UX/UI Development - Final Back End: Develop/Integration													
Sprint 8 feedback													
Package 4: Code Release to Github													
Internal Demo/Handover to New America													
Prototype Support													

Environment and Tooling

The following environments will be used to develop and deploy New America PoC:

- Local development environment
- Azure Cloud demo environment

The following technology stack will be used to develop New America PoC:

Corda:

- Corda Open Source 4.5
- Platform Version 7

Backend:

- Spring boot webserver 2.0.2 RELEASE
- Java 8

Frontend:

- React 16

Database:

- H2 (Native Corda database)

Appendix A

Information originally published here. Relevant information related to bare-metal based installation is copied here.

We have received many requests to compare the cost of deploying using Kubernetes versus a traditional bare-metal based installation.

Although the answer will be dependent on the use-case specific details, for example are we talking about high-frequency trading with high number of transactions per second or are we talking about high quality asset issuance which occurs much less frequently, we can still generate some rough estimates that hopefully will be useful as indications.

Notes

Note that if you just want to use this deployment for testing, you will have a fraction of the costs available to you. You can eliminate the database costs by using H2 file database (built-in to Corda). You can also use just 1 large server (4 cores and 16 GB RAM) or 2 mid-sized servers (2 cores and 8 GB RAM) to host the whole cluster.

Basic building blocks

Let's start by defining the basic building blocks that we will be using in both the bare-metal and the Kubernetes deployment cost calculations. This may not be the most realistic case, you may end up using slightly different sized machines in the two scenarios, but for the sake of comparison, we'll make this simplification.

So let's start with the virtual machine (VM), we'll use a typical server with 2 cores and 8 GB of memory as the base building block. See the details in the specification section below.

The reason why we chose this type is that it should be sufficient to run most Corda applications without issues, but still it is considered one of the smallest sizes available, which means, if you wanted to increase performance, so would the cost increase. For more information on sizing and performance please see Corda Sizing & Performance.

Let's add more detail to the deployment, let's look at a typical deployment of Corda, which is comprised of a Corda node, Corda firewall, a vault database, a webserver, loadbalancer and a cloud HSM.

Corda Enterprise Network Manager (CENM)

We will also add the CENM setup to the list, just to have an overview of what it might mean if you were running your own private Corda network with the Corda Enterprise Network Manager. A CENM setup is comprised of an Identity Manager, a Signing Service, a Network Map and a Notary cluster.

Please see Corda Enterprise Network Manager for more details.

You will also require a license, see CENM Evaluation License for more information.

Specification

VM spec (2 cores and 8 GB of memory):

- AWS: m4-large ($0.10/h, $73/month)
- Azure: Standard_D2s_v3 ($0.117/h, $85.41/month)
- GCP: n2-standard-2 ($0.0971/h, $70.883/month)

HDD spec:

- AWS: 100GB ($4.50/month)
- Azure: 100GB ($4.60/month)
- GCP: 100GB ($4.00/month)

Database (DB) spec (*): 4 vCores, 500GB storage (some discrepancy between the different cloud providers make comparison slightly uncertain, please be skeptical on GCP DB pricing in particular)

- AWS: db.m5.xlarge SQL Server ($1.224/h, $893.52/month) + storage SSD 500 GB ($112.50) = $1006.02 total/month (https://aws.amazon.com/rds/sqlserver/pricing/?nc=sn&loc=4)
- Azure: Microsoft.SQLDatabase 4vCore + data max size 500 GB ($925.66/month) (https://azure.microsoft.com/en-gb/pricing/calculator/)
- GCP: 4vCPU, 16 GB RAM, 4x$30.15+4x$5.11+500*$0.170/month = $120.6+$20.44+$85=$221+license $343.1 = $564.1 total/month (https://cloud.google.com/sql/pricing#sql-server)

Cost calculation: CENM in traditional bare-metal setup

Keep in mind, that if you are using the Corda Network, this setup is hosted by the Corda Network Foundation and you should not have to consider this cost.

Please note that all costs are per month in this table and in USD. (only direct VM cost + HDD cost considered) Cloud HSM is listed but not calculated, the pricing models will vary wildly depending on how you use them.

Type	VMs	HDD	AWS	Azure	GCP
Identity Manager	1	100 GB	$77.50	$90.01	$74.88
Signing Service	1	100 GB	$77.50	$90.01	$74.88
Network Map	1	100 GB	$77.50	$90.01	$74.88
CENM Database(HA)	2*	500 GB	$2012.04	$1851.32	$1128.20
Notary Cluster	3	100 GB	$232.50	$270.03	$224.65
Notary Cluster DB	3*	500 GB	$3018.06	$2776.98	$1692.30
Cloud HSM Keys x3	-	-	-	-	-
Total	6	-	$5495.10	$5168.36	$3269.78

Cost calculation: Corda Node in traditional bare-metal setup

Please note that all costs are per month in this table and in USD. (only direct VM cost + HDD cost considered)

Cloud HSM keys breakdown: (1 Node CA per node + 1 Legal Identity per node + 1 TLS per node) x 2 (the reason for two nodes is we are using Hot-Cold HA (High availability)) (optionally 1 Artemis access token + 1 Artemis root in HSM) (Artemis can be used as a standalone component, which is the recommendation for high

throughput) (optionally 1 tunnel root + 1 tunnel key + 1 bridge key in HSM) (Corda firewall is an optional component which is recommended to achieve high security)

Type	VMs	HDD	AWS	Azure	GCP
Corda Node	2	100 GB	$155.00	$180.02	$149.76
Node Database(HA)	2*	500 GB	$2012.04	$1851.32	$1128.20
Artemis MQ	2	100 GB	$155.00	$180.02	$149.76
Corda Bridge	2	100 GB	$155.00	$180.02	$149.76
Corda Float	2	100 GB	$155.00	$180.02	$149.76
Webserver	2	100 GB	$155.00	$180.02	$149.76
Loadbalancer	-	-	$22.42	$23.25	$18.25
Cloud HSM Keys x6	-	-	-	-	-
Total	10	-	$2809.46	$2774.67	$1895.25

About R3

R3 is an enterprise software firm working with a network of over 200 banks, financial institutions, regulators, trade associations, professional services firms, and technology companies to develop Corda, its blockchain platform designed specifically for businesses. R3's global team of over 160 professionals in nine countries is supported by over 2,000 technology, financial, and legal experts drawn from its global member base.

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