Atomix Litepaper

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www.atomix.ai

Overview

Atomix is a borrowing and lending platform implemented in large part on blockchain, giving maximum transparency. By using a cryptocurrency token to represent the value of the collateral, we decouple the lenders from the borrowers.

This document is a lite-paper describing the functionality of the system.

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Participants

Originators/Borrowers

An early target is small to medium size borrowers seeking secured lines of credit but who have difficulty sourcing finance from traditional sources in the credit market. Example businesses are Alternative Finance lenders such as Bridging Lenders and other property professionals seeking secured loans etc. Some of these businesses have the right to receive future cash-flows which they would like to convert to funds in the present to free up capital for operations and expansion in exchange for providing security over their assets (including the right to receive cash-flows and any related security) as collateral. Atomix will provide them near-instant, flexible access to liquidity on competitive terms. Other businesses own, or wish to acquire, real estate assets (which may or may not themselves generate income) against which they would like to raise funds.

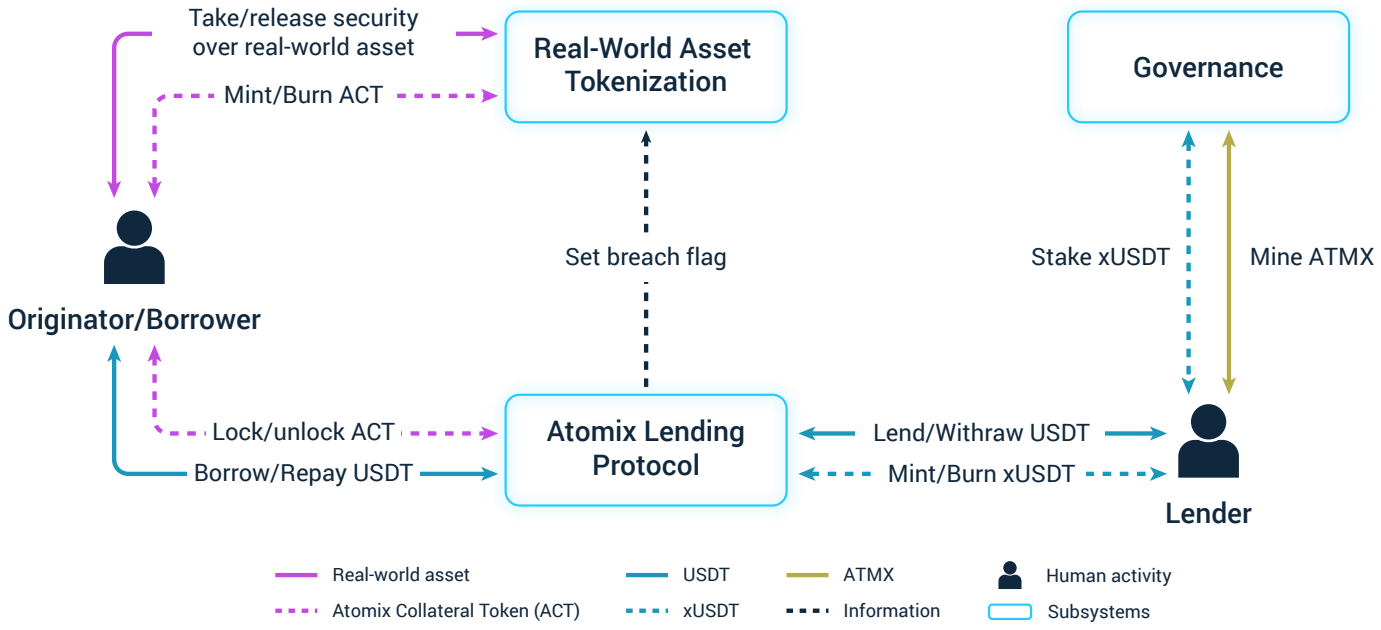
Security will be taken over an Originator's assets to secure the ongoing payment obligations of the Originator under the loan from Atomix and tokens which evidence that security will be given to the Originator. Those tokens must be deposited with Atomix for the Originator to draw down under the loan, at which point the Originator becomes a Borrower for the purposes of this Litepaper.

Lenders

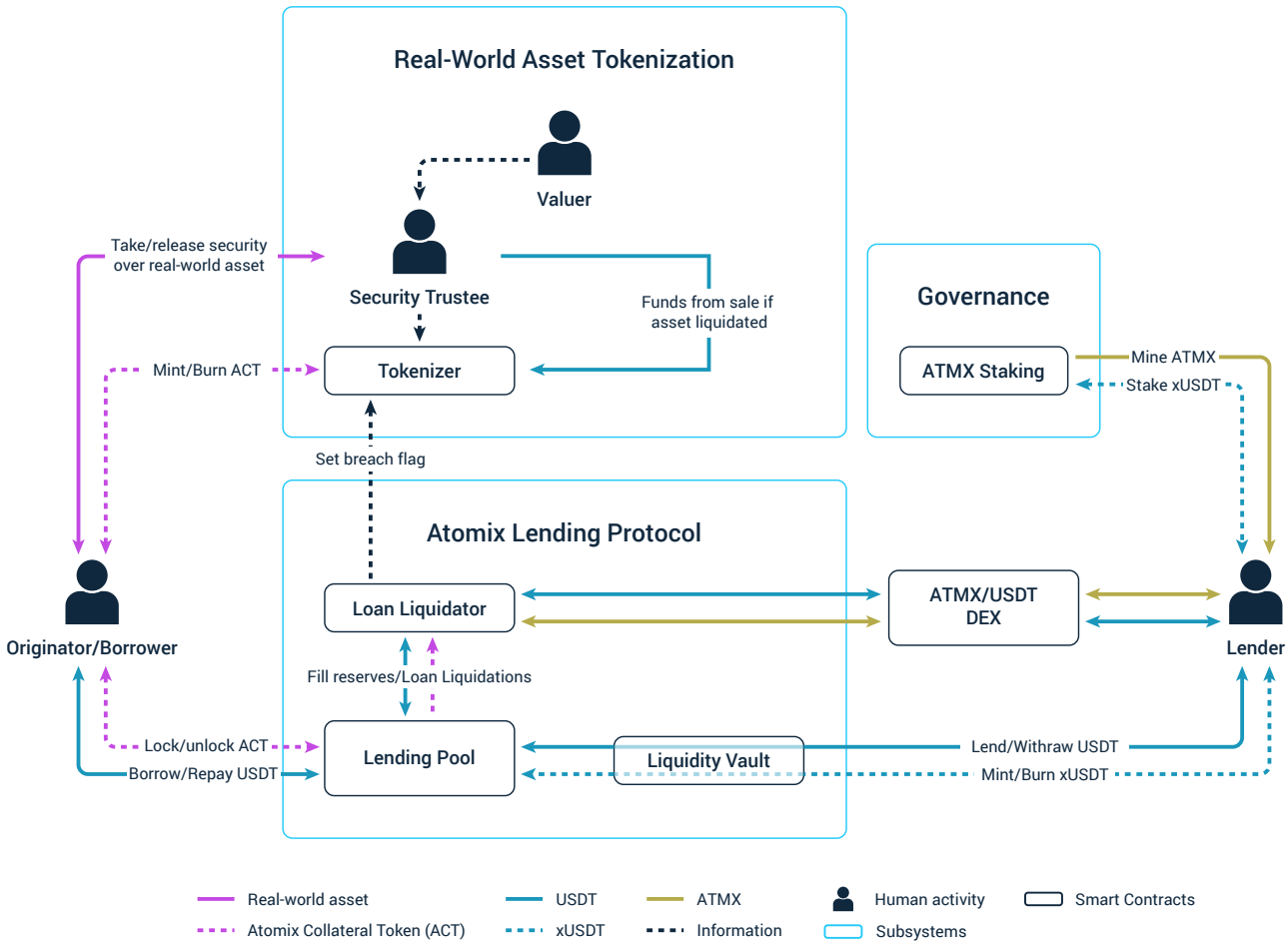
Lenders have funds available for investment and want to receive competitive returns from a low risk diversified portfolio. They can also earn governance tokens which can be used to influence the protocol or sold on the open market.

System Overview

This diagram shows the three main subsystems.



This is a more detailed version of the previous diagram showing the main components of each subsystem.



Part 1: System design

Tokens

There are a number of different crypto-tokens in the system. Their movement is described by colored lines in the main system diagram.

USDT

This is Tether. A token already in wide circulation on the Ethereum blockchain. It is a “stablecoin” designed to maintain a 1-1 exchange rate with the US dollar.

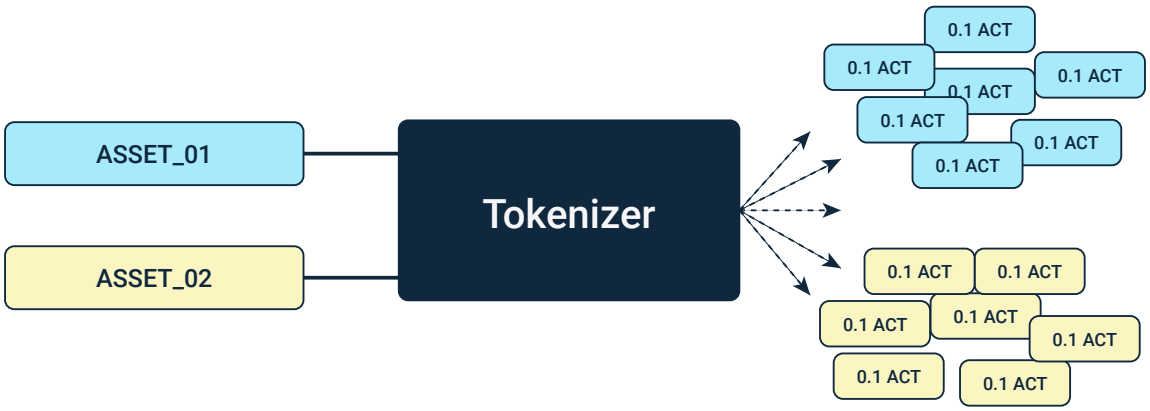
https://www.coingecko.com/en/coins/tether/usd

All secured assets in the system are valued in terms of USDT.

When interacting with smart contracts, users need to use a stablecoin crypto-currency such as USDT to represent a fiat currency. U.S. dollars (fiat) can be exchanged for USDT in a number of external crypto-exchanges. These exchanges are not part of the Atomix system.

Atomix Collateral Token (ACT)

This is a crypto-token minted by the Tokenizer. For each asset which security is taken over, one ACT will be minted. This token is infinitely divisible. Fractions of this ACT are fungible with respect to each other. However a fraction of an ACT minted against one asset is not interchangeable with ACT minted against a different one.



In the example above, you can only release security taken over the ASSET_01 by burning blue ACT. You cannot use the blue ACT to release security taken over the ASSET_02.

xUSDT

This token is deflationary token minted by the Lending Pool and represents a lender's deposit of USDT. When a lender deposits USDT, the system mints and transfers xUSDT to the lender in return. This xUSDT monotonically increases in value over time so when the Lender returns it to the system they will withdraw more USDT than their original investment.

ATMX

These tokens are sold on the open market as well as distributed via a staking contract to owners of xUSDT. Owners of ATMX have voting rights on deciding system parameters. The value of ATMX will also track the financial fortunes of the protocol: when the protocol is making a profit, ATMX will increase in value.

Real-World Asset Tokenization

This subsystem deals with valuing real-world assets, creating security over those assets and minting tokens representing them. It also deals with burning the tokens to release the security as well as enforcing the security when necessary in order to liquidate the real-world asset.

Security Trustee

An SPV which acts as the interface with Originators in assessing the suitability and value of an Originator's Assets as collateral. The Security Trustee is also responsible for:

- Generating the security document which creates security over an Originator's Assets and digitally confirming that it has been executed by the Originator
- Instructing the Tokenizer to mint ACT
- Acting as a traditional security trustee with power to enforce the security taken over the relevant real-world assets when a Borrower is in breach.

Valuer

The valuer gives an estimate of the Risk-Free value of an Originator's assets. This estimate will be used by the system for a specific time period (say 2 years). The valuation is used to determine the value of the one ACT token minted.

Risk-Free Value

The value ascribed to an Originator's Assets representing the amount which the Valuer is confident will be recovered if the security over that Originator's Assets were to be enforced and the Assets liquidated in the open market. For an asset like land, which does not fluctuate wildly in value, the Risk-Free Value could be high, e.g. 75% of the full value of the asset. For more volatile assets, it could be just 50%. It should also reflect any losses the system is likely to incur due to fees.

The Originator will be able to take out insurance to cover the risk that the asset fails to meet this sale-price if liquidated.

Real-world asset and Secured Asset

Real-world assets are the assets owned by an Originator over which security will be taken.

Once security has been taken over real-world Assets, we have Secured Assets, an ACT token will then be minted which evidences the Secured Assets.

Tokenizer

The Tokenizer is a smart contract used by the Security Trustee to mint and burn ACT, which evidences security taken over an asset. It is where the value of the Secured Asset is stored and updated. It is also used by the lending system to flag Secured Assets as in breach and therefore in danger of liquidation.

Security taking process

When security is taken over Assets, that Asset is now a Secured Asset, and ACT will be minted evidencing the Secured Asset. To release the security taken over the Asset all the ACT evidencing the security taken over that asset must be burnt.

Taking security over an asset:

1. Originator requests that the Security Trustee creates security over the real-world asset
2. A valuer provides a risk-free valuation
3. Security Trustee creates the security documentation which is signed by relevant parties
4. Security Trustee notifies the Tokenizer that security has been taken over the asset following which the Tokenizer mints 1 ACT which it passes it to the Originator

Releasing a security:

1. Originator uses the Tokenizer to burn their ACT
2. Originator requests that the Security Trustee releases the security held over the asset
3. Security Trustee confirms with the Tokenizer that all ACT have been burnt
4. Security Trustee releases the security held over the asset

ACT Invariant

Once a specific secured asset, S_0 , is created and 1 ACT_0 token minted against it, then there are a number of actions can be performed using the Tokenizer including:

- Revaluing the ACT_0 token
- Burning a portion of the ACT_0 or minting more of it
- Revaluing the underlying asset itself
- Replacing the secured asset with cash from a sale (in the case of liquidation)

All of these actions must preserve a crucial invariant we call the ACT invariant.

Definitions:

Value(S):	*Value of the Secured Asset*
N:	*Quantity of ACT_0 in existence*
Value(1ACT_0):	*Value of 1 ACT_0*

Then the following invariant must be preserved:

$$Value(S) \geq N \times Value(1ACT_0)$$

Security Trustee actions

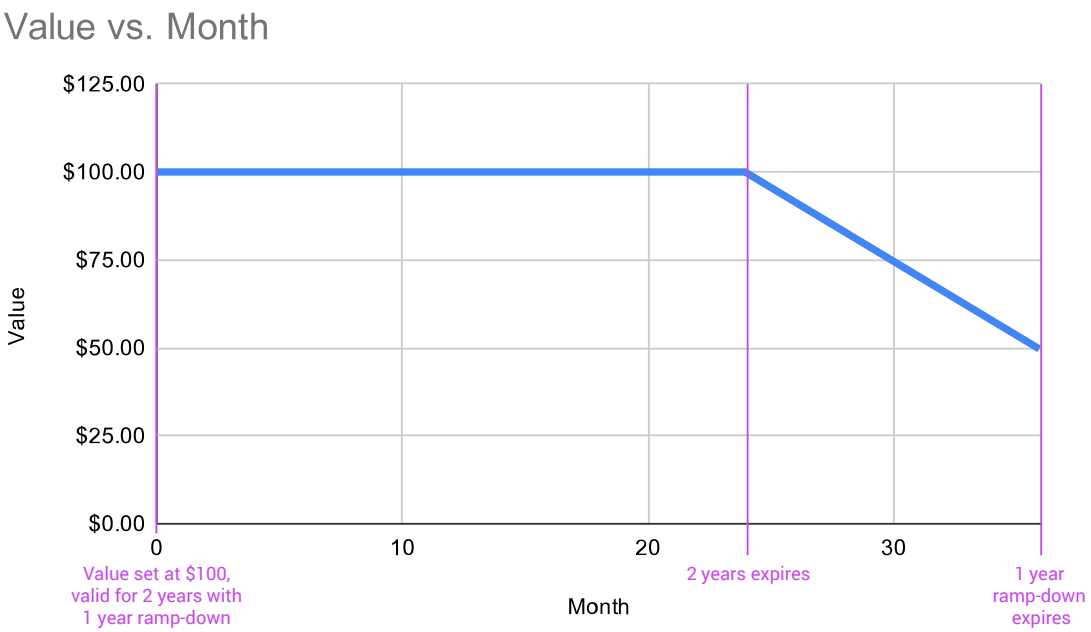
There are various actions that the Security Trustee needs to perform with the Tokenizer:

- Taking security over an Asset and minting ACT in relation to the Secured Asset
- Burning ACT and releasing the secured asset
- Managed revaluation (change quantity of ACT minted)
- Unmanaged revaluation (change value of 1 ACT)

If a secured asset has been liquidated and replaced by USDT, holders of ACT can burn just a portion of the ACT and claim a portion of that USDT.

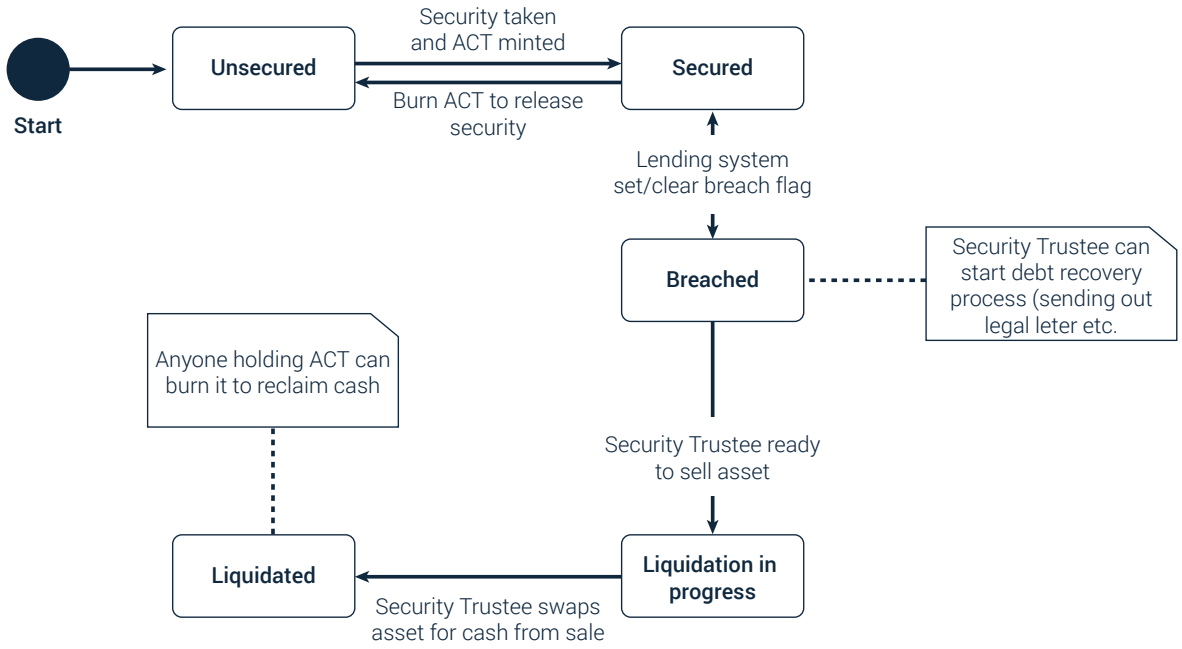
Time-limited valuations

When the valuer assigns a risk-free value to a secured asset, it will be valid for a specific period of time. However, rather than having the value suddenly drop to zero value after this period, the system will also assign a ramp-down period over which the value will steadily drop to half its original value.



Real-world Asset Liquidation

An asset can be in a number of different states. Its state is tracked by the Tokenizer.



It starts off in an unsecured state. The Security Trustee takes security over the asset and mints 1 ACT creating a secured asset. The Originator is now free to lock up their ACT as collateral in the borrowing/lending platform. The borrowing and lending platform can set and clear a breach flag on the security indicating if the borrower has breached the terms of their loan.

While in the Breached state, the secured asset is in danger of liquidation. The Security Trustee can now start the debt recovery process (e.g. sending out warning letters). During this time, the borrower can always pay off their debts to reclaim their ACT and burn it to release the security.

If, at the final stage of the debt recovery process, the secured asset is still in a breach state, the Security Trustee can sell the asset and the state changes to Liquidation in Process. The security cannot now be released by the originator burning ACT - they must wait until the Liquidation is complete.

When the sale is ready to go through, the Security Trustee confirms that the state is Liquidation in Progress and if so performs the sale and swaps the asset referenced by the ACT with the cash (in the form of USDT) from the sale. Doing this sets the asset state as Liquidated. Now anything holding ACT that was evidencing security over the real-world asset can claim their share of the USDT.

Atomix Lending Protocol

An Originator can lock up their ACT in the Atomix Lending Protocol and become a Borrower. This subsystem lets borrowers take out USDT loans backed by ACT tokens and lenders to lend USDT to earn rewards.

Lending Pool (LP)

The Lending Pool is the smart contract responsible for allowing borrowers to deposit ACT and borrow USDT against it and also allowing lenders to deposit USDT and earn a return.

Borrowing collateral factor

Each borrower has a borrowing limit which is a portion of the value of all the ACT they have locked up. This portion is called the Borrowing Collateral Factor. It is likely to be between 60% and 80% and is the same for all borrowers but it may vary depending on the type of secured asset evidenced by the ACT.

Borrowing

The moment that borrowers borrow, the loan starts accruing interest which adds to the value of their loan. The borrower needs to ensure that their loan does not exceed their borrowing limit. At any time, the borrower can repay any portion of their loan, borrow more USDT or deposit or withdraw ACT as long as they stay within their borrowing limit.

Lending

Lenders can deposit USDT. When they do this, they are issued xUSDT tokens which increase in value over time. When the lender comes to return their xUSDT tokens they will get more USDT back than they originally put in. In the unlikely event that there is no USDT available in the protocol, then lenders will be prevented from withdrawing until there is some available.

Interest and returns algorithm

The Atomix borrowing interest rate is the same for all borrowers and is set algorithmically based on supply and demand of USDT within the system. There will be a min and max APR defined as part of the governance of the system and the borrowing rate can never go outside these limits. The lending reward rate is the same for all lenders. It is also set algorithmically and will always be less than the borrowing rate.

In addition, the total income from borrower interest will always be more than the outgoings due to lender rewards. This spread results in an income-stream which is used to maintain the reserves of the Loan Liquidator.

The rates are calculated as follows.

Constraints:

The system will only allow borrowing of USDT if there is USDT available to borrow. This means that the total USDT borrowed will always be less than the total USDT lent.

Tuning parameters:

R_{min}: Minimum APR for borrowers

R_{max}: Maximum APR for borrowers

S: Spread proportion (between 0 and 1)

Input variables

D_t: Total value of USDT lent by lenders

B_t: Total value of USDT borrowed by borrowers

We can now define the Utilization ratio (the proportion of the available funds are actually being borrowed):

$$U_r = \frac{B_t}{D_r}$$

Note that this Utilization ratio will always be between 0 and 1.

We can now calculate the Atomix borrowing interest APR:

$$B_{apr} = R_{min} + U_r \left(R_{max} - R_{min} \right)$$

When the Utilization Ratio is 0 (none of the funds are being borrowed) the borrowing APR is at its minimum. When it is 1 (all available funds have been borrowed) the APR is at the maximum.

We calculate the Atomix Lending reward APR:

$$L_{apr} = B_{apr}\ U_r\ (1-S)$$

With the spread set to zero, all income from the borrower's interest will be given out to the lenders in proportion to the amount they have lent. If the spread is 0.5 then only half of the interest is distributed in this way and the other half is diverted to the Loan Liquidator reserves.

Liquidation interface

A borrower can end up breaching their borrowing limit. To deal with this situation, there is a Liquidation interface in the Lending Pool available only to the Loan Liquidator smart contract.

If a loan has breached its borrowing limit, the Loan Liquidator can step in and pay off a portion of the loan in return for a portion of the ACT. The liquidator decides how much to pay off and how much ACT to take.

Filling the Liquidation Reserves

The spread between the borrowing interest rates and lending reward rates generates a USDT income which is used to fill a pool owned by the Loan Liquidator. This pool is used to fund Loan Liquidations.

The Loan/Collateral Invariant

A crucial invariant of the Lending Pool is that there is always more value locked up in collateral than the value of USDT loaned out. To formalize this, we can determine:

- The value of all the ACT locked up in the LP: ***Value(assets)***
- The value of all minted xUSDT: ***Value(xUSDT)***
- The total amount of USDT locked up in the LP: ***Value(USDT)***

The Invariant can be stated as:

$$Value(USDT) + Value(assets) \geq Value(xUSDT)$$

This table shows an example of the invariant in action over time.

Time	Action	Value (USDT)	+	Value (assets)	≥	Value (xUSDT)
0	Initialize	$0	+	$0	≥	$0
1	Lender deposits	$150	+	$0	≥	$150
2	Time elapses (no interest)	$150	+	$0	≥	$150
3	Borrower locks ACT	$150	+	$100	≥	$150
4	Borrower borrows: Loan = $70	$80	+	$100	≥	$150
5	Time elapses: Loan = $80	$80	+	$100	≥	$160
6	Borrower repays	$160	+	$100	≥	$160
7	Borrower withdraw ACT	$160	+	$0	≥	$160

Suppose the Lending Collateral Factor is set to 80% so when the loan goes above $80 it gets liquidated.

Time	Action	Value (USDT)	+	Value (assets)	≥	Value (xUSDT)
5	Time elapses: Loan = $80	$80	+	$100	≥	$160
6	Time elapses: Loan = $90	$80	+	$100	≥	$170
7	Asset liquidated	$180	+	$0	≥	$170

Loan Liquidator (LL)

If an account breaches its borrowing limit, the Loan Liquidator steps in. It pays off some of the borrower's debt to the LP and receives a portion of the ACT tokens in return. This is called a Loan Liquidation. This brings the loan to the LP back below the borrowing limit.

Now the Borrower's debt to the LP is smaller, but it now also owes a debt to the Loan Liquidator, which now also holds ACT as collateral against that debt. The Loan Liquidator, charges interest on the debt at some multiple of the standard LP borrowing rate (say 2X).

The borrower has a borrowing limit with the Loan Liquidator, set as a proportion of the collateral held by it. That proportion is called the Liquidation Collateral Factor and will be higher than the Borrowing Collateral Factor (which determines the borrowing limit to the LP).

It is possible for the borrower to breach the Loan Liquidator's borrowing limit just as it could breach the LP's limit. A loan liquidation is triggered if the borrower breaches either borrowing limit.

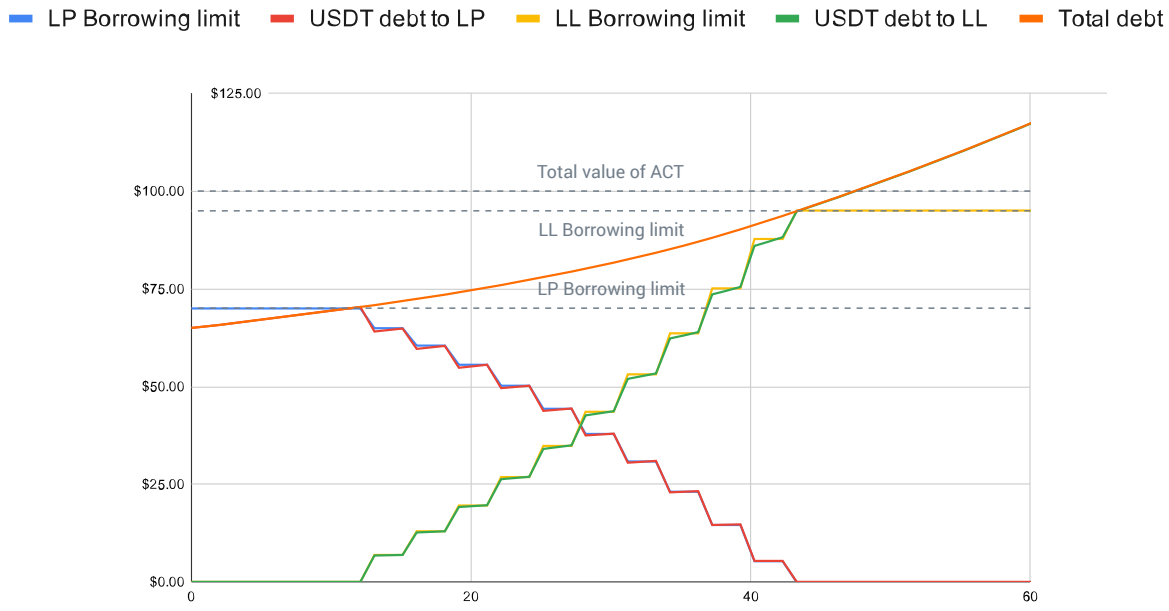
After a Loan Liquidation, the debt to the LP will always be back within the Borrowing Collateral Factor limit - even if that means transferring all the debt over to the Loan Liquidator.

At any time the borrower can pay off the debt to the Loan Liquidator and recover their ACT - it will be transferred back to the Borrower's wallet.

If the Loan Liquidator holds ACT, then it will set the breach flag on the Secured Asset evidenced by that ACT. If it no longer holds any ACT, then it will clear the flag.

Liquidation Bot

Anyone who notices that a loan is breaching its borrowing limits can trigger a loan liquidation. However, an off-chain bot will keep track of events output by the LP and LL and anticipate when loans are likely to be breaching their limits and ensure Loan Liquidations are triggered in good time.



Loan Liquidation Example

Suppose a borrower has a loan of $65 backed by ACTs worth $100. Time in months is on the x-axis.

This graph shows the loan to the LP steadily accruing interest until it breaches the Borrowing Collateral Factor limit ($70). At this point the Loan Liquidation kicks in and transfers ACT to the Loan Liquidator in return for the paying off some of the debt. This ensures the loan is back within the borrowing limit, then when it breaches again, another Loan Liquidation is triggered.

This would continue until all the loan has been transferred to the LL, however, in reality we expect the real-world asset to be liquidated long before all of the loan is transferred at which point the loans will be "cashed in" - see later.

The orange line shows the total combined debt the borrower has to both LP and LL.

Math

This section derives the formulas that the LL uses to determine how much ACT and USDT to transfer. Any percentages will actually be stored as values between 0 and 1 (so 2% would really be 0.02 when we do the calculations).

Notation: There are a number of parameters which have equivalent versions in the Lending Pool and the Loan Liquidator. In this case we give them the same name, but the Loan Liquidator versions have an added prime (') to distinguish them.

Tuning Parameters

These are system-wide parameters of the Liquidation algorithm that can be set by governance.

> ***C_o: Collateral Overshoot*** - Amount below the borrowing limit that the loan should be after a Loan Liquidation. E.g. if this is set to 2% and the Borrowing Collateral Factor was 60%, then after a Loan Liquidation, the remaining loan would 58% of the value of the remaining collateral, ensuring some breathing space before needing to liquidate again.
>
> ***I_m: Liquidator Interest rate multiplier*** - Multiple of the LP borrowing interest rate charged by the Loan Liquidator.
>
> ***C_f': Liquidation Collateral Factor*** - The Borrowing limit of the Loan Liquidator as expressed as a proportion of the value of the collateral held by it.

External turning parameters

These are system-wide parameters of other components which impact the behaviour of the Liquidator.

> ***C_f: Borrowing Collateral Factor*** - The Borrowing limit of the LP as expressed as a proportion of the value of the collateral held by it.

Input Parameters

These are variables which will be different each time a Loan Liquidation occurs.

> ***C_v: ACT Value*** - The total value of 1 ACT
>
> ***C_a: LP ACT Amount*** - The amount of ACT held by the Lending Pool as collateral
>
> ***L_a: LP Loan Amount*** - Value of USDT borrowed from the Lending Pool
>
> ***C_a': LL ACT Amount*** - Amount of ACT held by the Loan Liquidator as collateral
>
> ***L_a': LL Loan Amount*** - Value of USDT borrowed from the Loan Liquidator

Loan Liquidation Criteria

A Loan Liquidation can be triggered if either the loan to the LP or the loan to the Liquidator breaches its borrowing limit. I.e. if:

$$L_a > C_v C_a C_f \quad \text{or} \quad L_a' > C_v C_a' C_f'$$

In either case, the Loan Liquidation calculations will be the same.

Loan Liquidation Calculations

We have the C_o; the Collateral Overshoot, which is the amount we want the LP loan to be below its borrowing limit after the Loan Liquidation. However, we also want C_o' - the amount the Liquidator loan should be below its borrowing limit after the liquidation.

We set this to be such that, if there is no other intervention other than both loans accruing interest, both the LP and Liquidator loan will next breach their limits again after the same amount of time has elapsed. This keeps the number of liquidation actions to a minimum.

I.e.:

$$C_o' = C_o I_m$$

Now we can set the target that each loan should be after liquidation as a proportion of the collateral held.

$$T_f = C_f - C_o$$
$$T_f' = C_f' - C_o'$$

To perform the liquidation, there are two values to calculate:

L_d: Amount of USDT to transfer from Liquidator to LP

C_d: Amount of ACT to transfer from LP to Liquidator

After performing these transfers, the LP loan amount should be equal to the target proportion of the collateral value.

I.e.

(1) $$L_a - L_d = C_v T_f (C_a - C_d)$$

And conversely for the Liquidator loan

(2) $$L_a' + L_d = C_v T_f' (C_a' + C_d)$$

We need to solve these simultaneous equations for Ld and Cd. If we do (1) + (2), the Ld disappears and we have a single equation in terms of Cd. We can rearrange this to get it in terms of Cd and then substitute this back into equation (1). Resulting in:

$$C_d = \frac{(L_a + L_a' - C_v C_a T_f - C_v C_A' T_f')}{C_v (T_f' - T_f)}$$

$$L_d = L_a - C_v T_f (C_a - C_d)$$

Cashing-in loans

If an underlying asset has been liquidated by the Real-World Asset Tokenization system, then both the LP and the LL can use the USDT which now backs the ACT to pay off any debts collateralized by that ACT.

To do this, the LP or LL can call the Cashing-in interface on the Tokenizer and burn the ACT they hold in return for a portion of the USDT. They use this USDT to pay off the debt that was backed by that ACT. Any residual USDT left over after paying off the debts is transferred to the borrower.

The LP can only do this if the USDT it would get actually covers the debt it is trying to pay off. It checks if this is the case before attempting it. The Loan Liquidator does not have this constraint.

The LP and LL can be instructed to attempt this operation by the borrower.

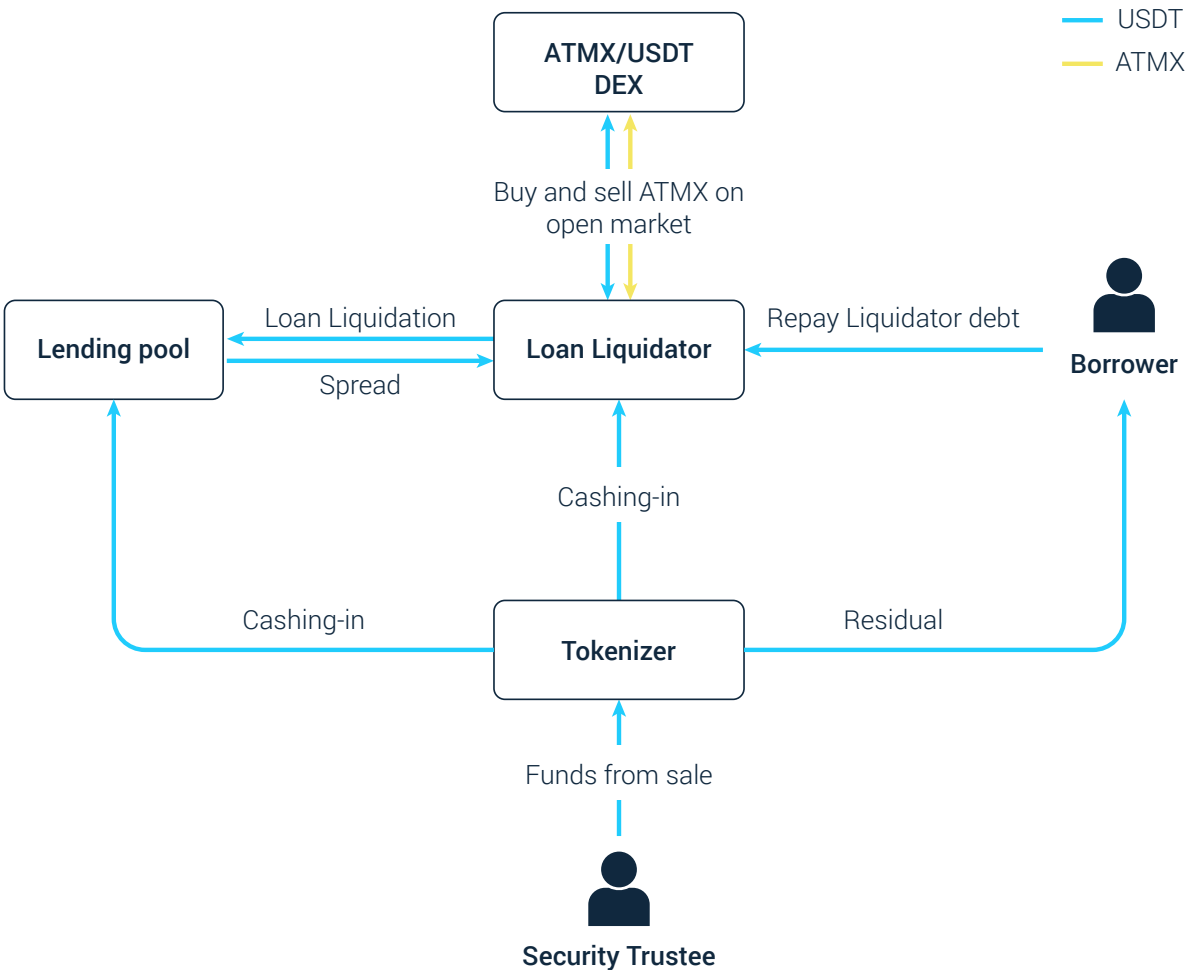
Loan Liquidation on Liquidated Asset

It is possible that a Loan Liquidation will occur on a loan whose secured asset has been liquidated. In this case, after the Loan Liquidation has been performed, both the LP and the LL cash in their loans automatically.

Also, when the real-world asset is liquidated, the Borrowing Collateral factor is raised from 70% up to something close to 100%.

Loan Liquidator Reserves and ATMX

The Loan Liquidator owns a pool of USDT and ATMX to fund Loan Liquidations. It is useful to understand how tokens flow in and out of this pool.



- The LL will start off with a reserve of USDT and ATMX.
- LP continuously feeds the spread between lending and borrowing interest into the pool.
- When the Loan Liquidator performs a Loan Liquidation, USDT is transferred back to the LP (in exchange for a portion of ACT - not shown).
- If the borrower wants to reclaim their asset on a breached debt, they repay the Loan Liquidator, which covers everything spent on loan liquidation up to that point.
- If the borrower does not do this, then the real-world asset is liquidated, the funds from the sale are transferred to Tokenizer as USDT and this replaces the secured asset which was evidenced by the ACT.
- Both the LP and LL then cash-in their loans recouping USDT and transfer any residual to the borrower.
- Finally, if the level of USDT in the pool gets too low, the Loan Liquidator will exchange some of its ATMX for USDT. If the level of USDT in the pool gets too high then it will exchange some of its USDT for ATMX.

This final process means that if the Atomix Lending Protocol starts losing money due to liquidations which fail to make back their risk-free value, more ATMX will be released onto the market reducing the value of ATMX. Conversely, if the system is making money, then ATMX will be drawn out of circulation, increasing its value. This mechanism allows ATMX holders to share in the fortunes of the protocol.

Liquidity Vault

The Liquidity Vault is a smart contract that sits between the Lender and the LP. It will have a simple interface allowing Lenders to deposit USDT in return for xUSDT and vice versa.

Initially the way it will do this is simply to pass through USDT and xUSDT in both directions between the Lender and the LP. However, in the future this strategy may change. The Liquidity Vault provides a layer of abstraction between the Lender and the mechanism for generating income. This will allow us to (e.g.) update the LP without affecting the token being held by Lenders.

Governance

This subsystem deals with usage and distribution of Atomix governance tokens, ATMX.

The purpose of the ATMX token is to enable stakeholders in the Atomix platform to govern the policies and fees in operation on the platform. In the ordinary course of business, ATMX will be distributed to providers of USDT to the Liquidity Vault via the ATMX Staking contract. This contract enables holders of xUSDT to stake them and receive an income stream of ATMX until they withdraw their stake.

In turn, ATMX enables the platform stakeholders to vote on policies such as min and max borrower interest rates and the target level of the Loan Liquidation USDT pool.

ATMX tokens are minted at linear rate and distributed to stakers in the ATMX Staking contract

In proportion to the amount of xUSDT they stake.

Roadmap

Initially Atomix will focus on tokenizing secured real-estate assets. However, in future it will diversify into tokenizing security over other real-world assets.

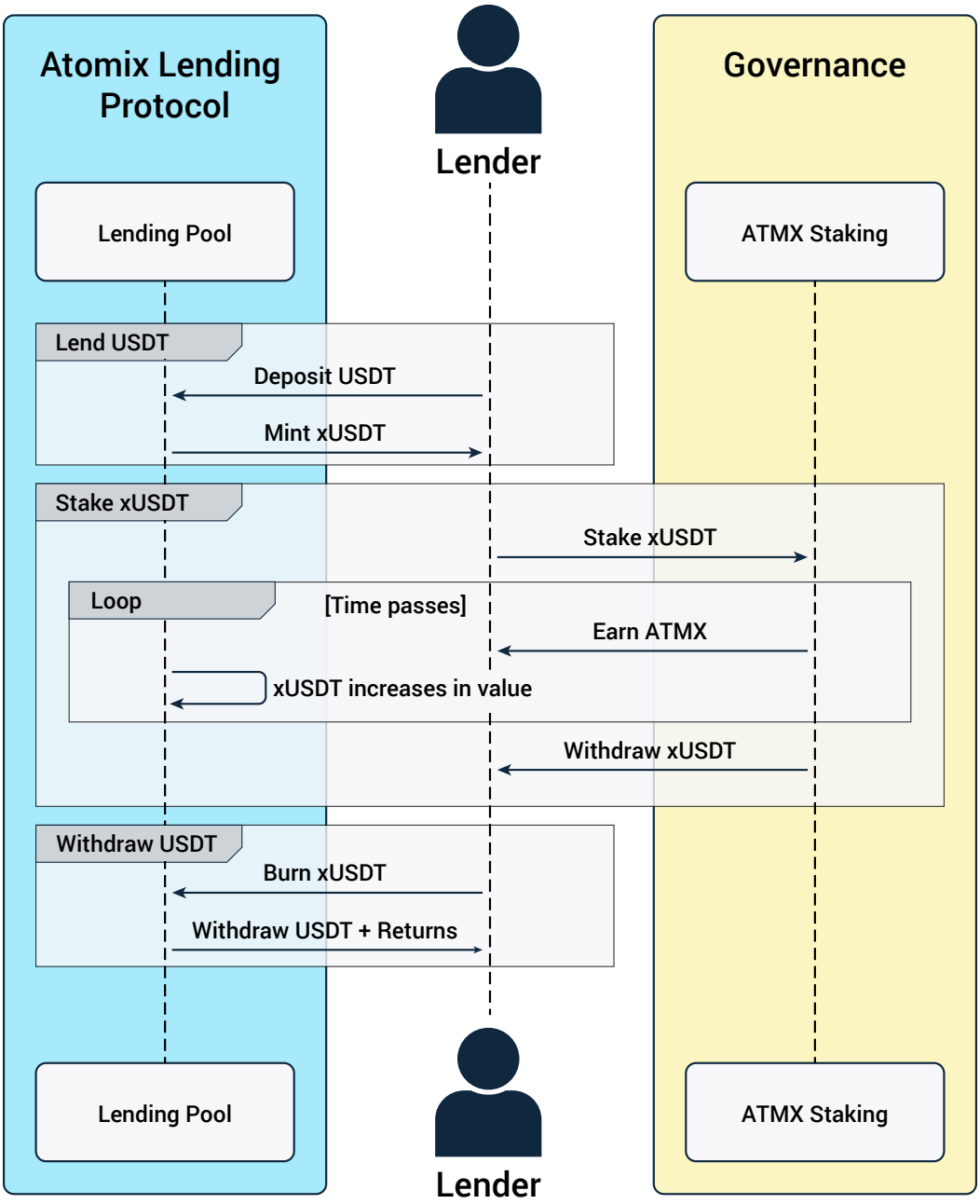
The initial release of Atomix uses the Ethereum ecosystem and some centralized components. In future it will use more Fetch.ai technology including:

- Using the Fetch.ai ledger for high transaction rates (c.f. Eth level 2 scaling).
- Fetch.ai agents and collective learning acting as oracles for more sophisticated real-time valuations of assets.

Part 2: User Journeys

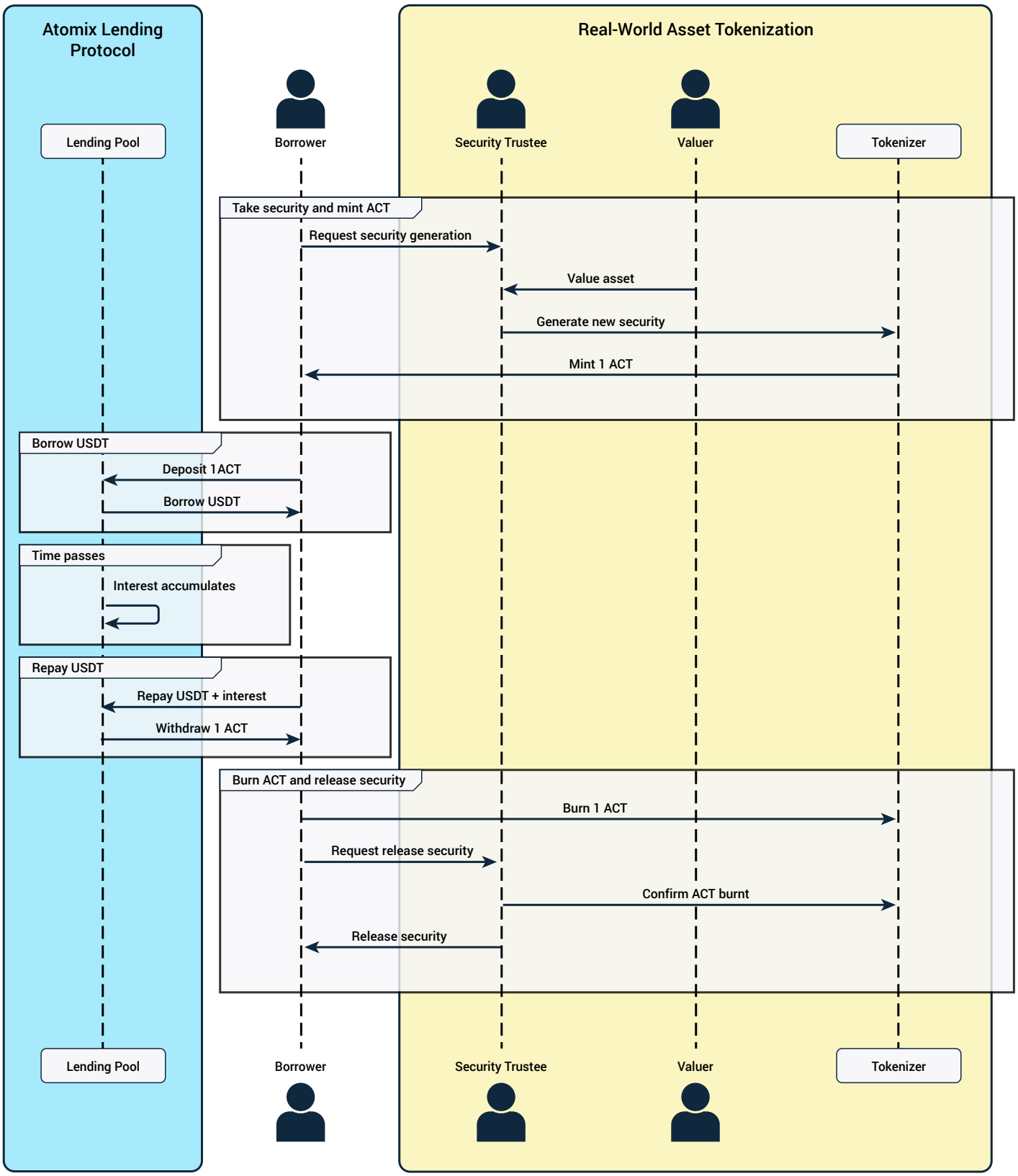
Lending, withdrawing and liquidity mining

This shows a standard lender journey.



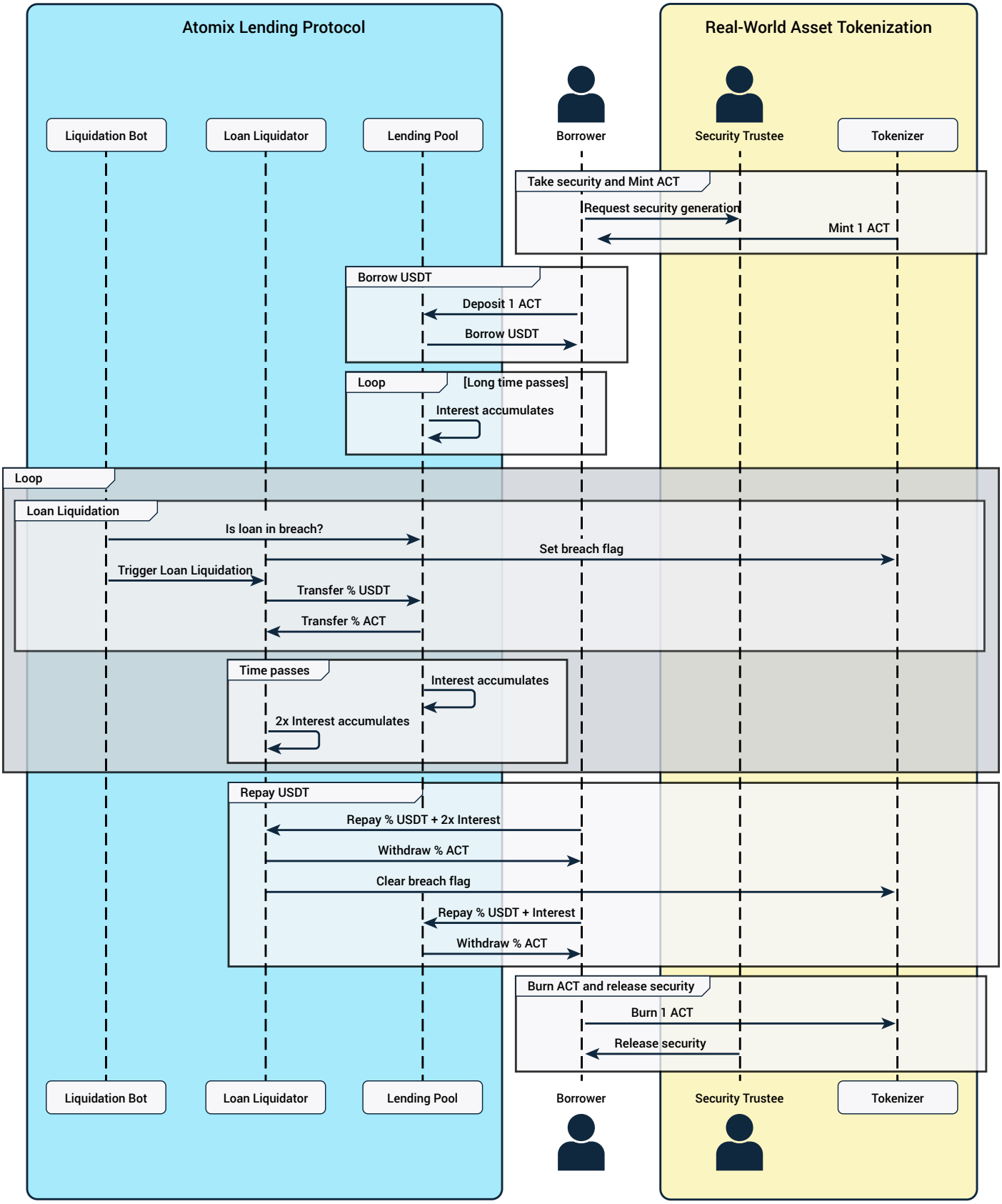
Borrowing and repaying

This shows a standard borrower journey.



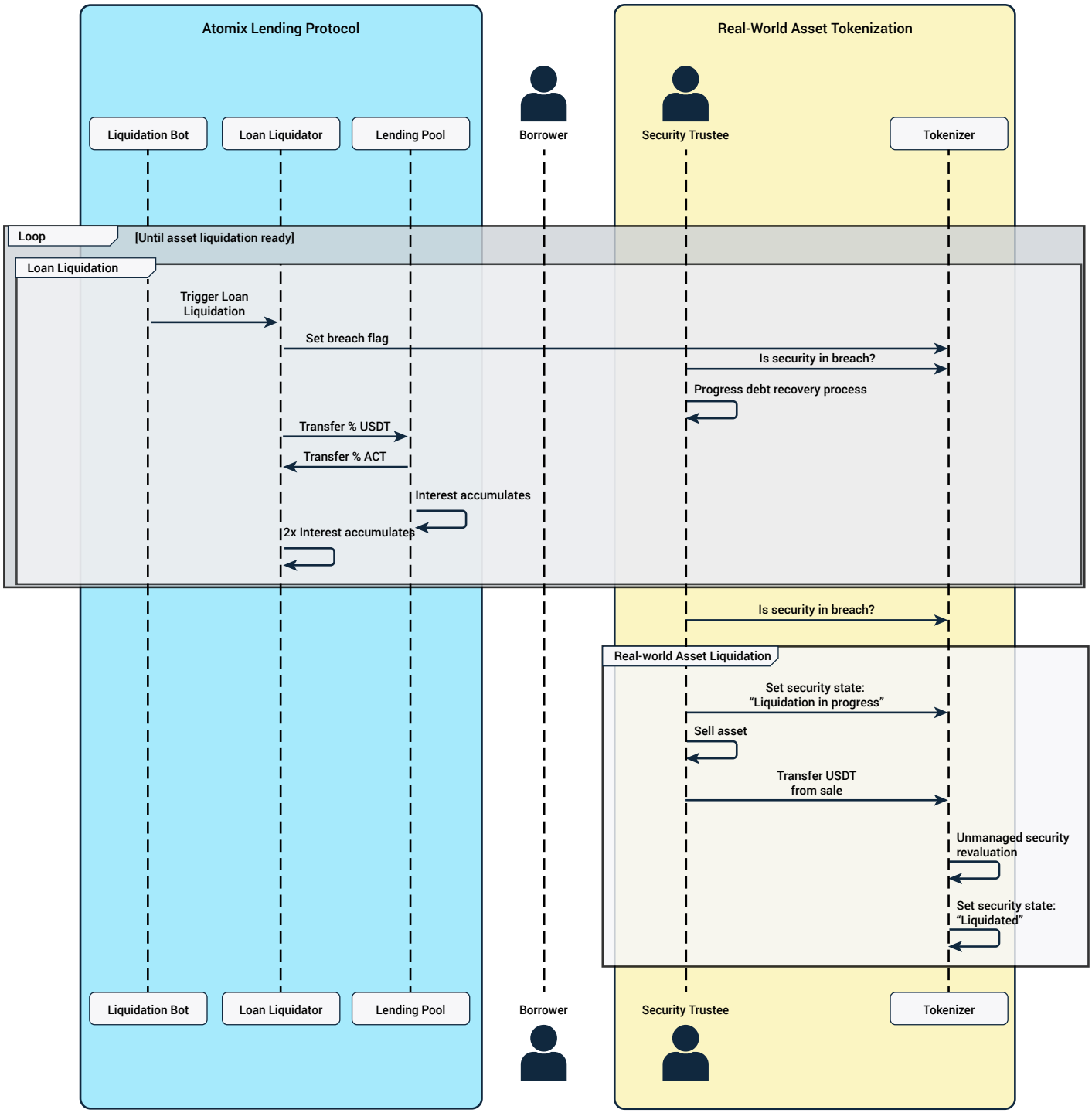
Breaching borrowing limit

This shows a borrower's journey, but instead of repaying in a timely manner, they let the debt grow until it breaches the borrowing limit. Then after a while they decide to pay off the debt and release their secured asset.



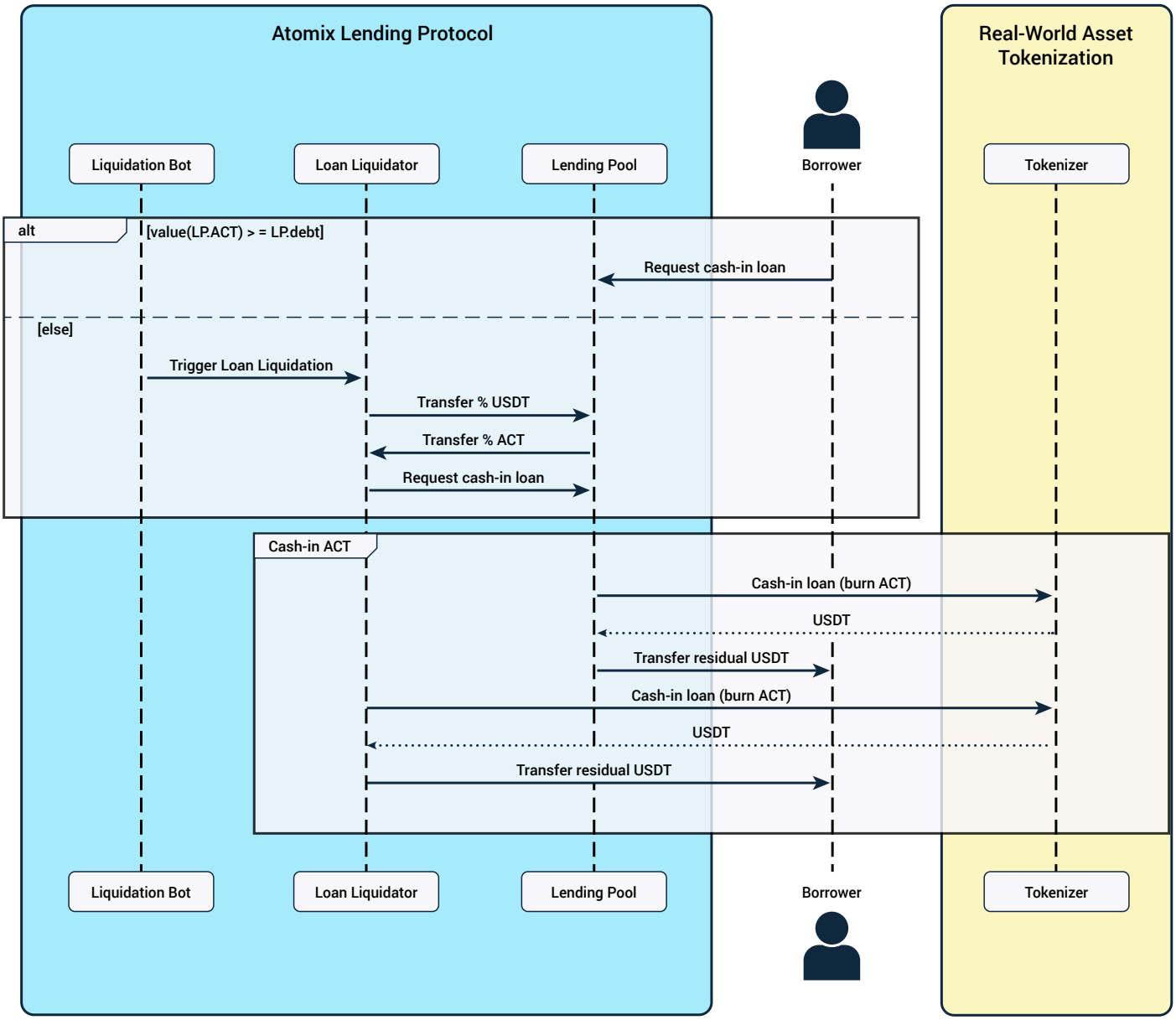
Real-world Asset Liquidation

The next two diagrams show how a series of loan liquidations result in triggering a real-world asset liquidation. We start the journey from the first loan liquidation.



After the real-world asset liquidation, there are two ways things can go. The ACT will have been revalued possibly up and possibly down. If the value of the ACT held by the LP is greater than the debt owed to it, then the same will be true for the LL and the borrower can trigger a loan cash-in to clear the debts and be paid any residual.

If this is not the case, then a loan liquidation will get triggered, this will rebalance the USDT and ACT between the LP and LL so that the ACT held by the LP will be enough to cover its debt and the loan cash-in gets triggered automatically after the loan liquidation.



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