Umee - Cross Chain DeFi Hub

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Abstract

Umee is a Cross Chain DeFi Hub that can collateralize assets on one blockchain towards borrowing assets on another blockchain. The platform specializes in allowing staked assets from POS blockchains to be used as collateral for borrowing across blockchains. The platform uses a combination of algorithmically determined interest rates based on market driven conditions. As a cross chain DeFi protocol, Umee will allow a multitude of decentralized finance products.

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References

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1) Introduction

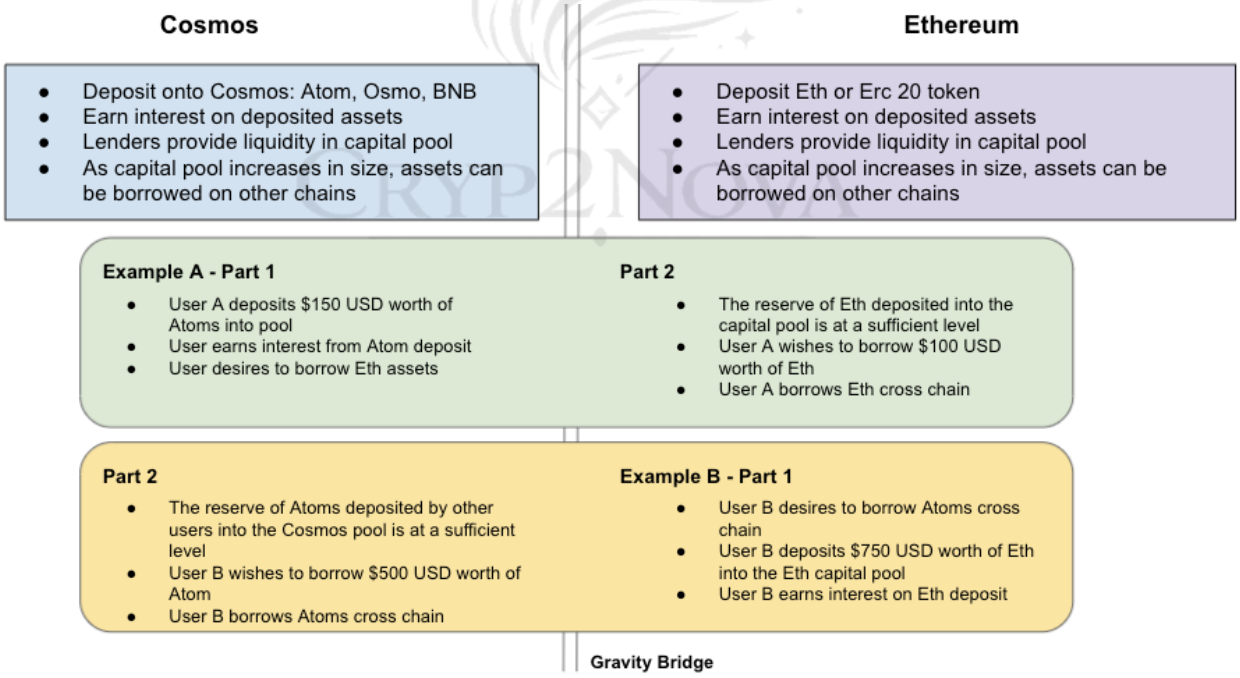
The initial implementation of this Cross Chain DeFi protocol will allow the ability to lend and borrow across blockchains. A Universal Capital Facility will contain access to both Ethereum and Cosmos network assets, effectively creating one single capital facility that users can interact with. A key distinguishing feature of Umee will be the ability to collateralize staked assets for borrowing across blockchains as users will have a choice to continue earning stake when engaging in DeFi. Umee will start with a base case scenario where users are able to lend and borrow assets across blockchains, similar to if they were participating in borrowing and lending activities on Compound or Aave. Concurrently, Umee will allow core functionality where holders of assets on a proof of stake blockchain such as Cosmos are able to collateralize their staked position in order to borrow assets on another blockchain such as Ethereum.

1.1 Borrow Position

A normal borrow position is detailed below:

Borrowers will be able to borrow assets from the Cosmos and Ethereum blockchains once they deposit sufficient collateral.

Figure 1



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When borrow positions are initiated, it is the uToken Collateral Token that is used as a collateral asset for borrowing on another blockchain.

1.2 Collateralize Staked Assets

Unlike normal borrowing and lending protocols, Umee will allow a key feature that involves staking assets and using those staked assets as collateral for borrowing assets on another blockchain.

> Example: Alice stakes Atoms onto the Cosmos network. While earning block rewards from her staking activity, she is able to concurrently utilize her staked Atoms as collateral to borrow DAI on the Ethereum blockchain. Alice utilizes the DAI for DeFi activities on Ethereum. She can also use the DAI to buy more Atoms and repeat this process.

Umee will also implement a mechanism where staking rewards from staked Proof of Stake assets can be immediately liquidated and used to pay the interest from borrowed positions.

> Example: Bob stakes Atoms onto the Cosmos network. Bob chooses to immediately liquidate the block rewards from his staked Atoms. He wishes to borrow DAI from the Ethereum blockchain and subsidize the interest payments that he would pay for borrowing DAI with the staking rewards. Bob could effectively borrow DAI at 0% interest if staking rewards are sufficient.

2 Universal Capital Facility

The Universal Capital Facility is where the Borrow Positions activity is conducted. After assets are sent to the Umee protocol, they can participate in the DeFi protocol via the Universal Capital Facility. The Universal Capital Facility will be built using Ethereum smart contracting language as well as Cosmos architecture based on Go Modules for building out the DeFi tools.

Umee will allow the ability to lend on one blockchain and borrow on another. For the first iteration, a user will be able to lend on the Ethereum blockchain then borrow assets on the Cosmos blockchain and vice versa.

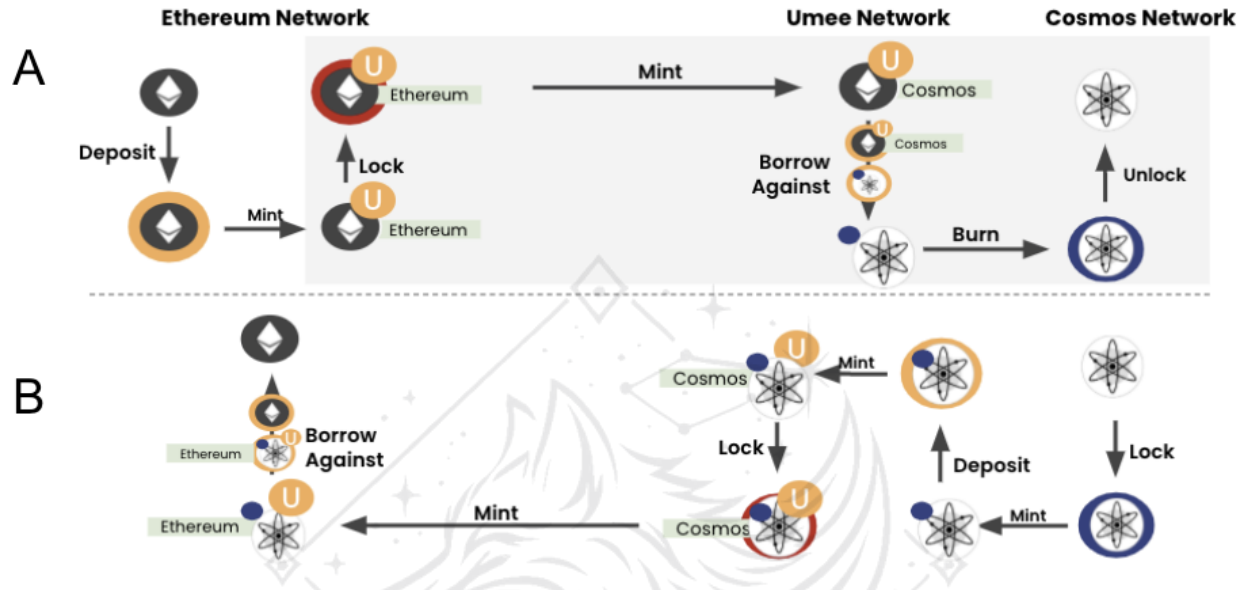
2.1) Understanding the uToken Collateral Token

The tokenization model is heavily inspired by Aave. Upon deposit of assets into the Asset Facilities, users will receive an amount of tokens called uTokens that map 1:1 with the asset deposited. uTokens are initially minted on Umee and can bridge over to Ethereum as ERC20

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tokens. The balance of uTokens grows over time by the underlying interest rate applied to the deposits. uTokens will employ an interest stream mechanism which means that a balance of uTokens will constantly generate income even when split or transferred.

Figure 2



When assets are locked on one blockchain, a uToken representing the collateral will be minted. This collateral token can be used as collateral to borrow assets on another blockchain. In the example diagram above, Ethereum is locked on the Ethereum blockchain and a uEth is created to be used for borrowing Atoms on the Cosmos blockchain. Additionally Atom is locked on the Cosmos blockchain and a uAtom is created as a collateral token to borrow Eth on the Ethereum blockchain.

When uTokens are created on one blockchain, they can be bridged over to the other blockchain to be used as borrowing collateral. In example A on Figure 1, an Eth is deposited to create uEth which is bridged over to the Umee network via Gravity Bridge to be used for borrowing native Cosmos Atoms. The Cosmos Atoms were originally sent to Umee via IBC.

In example B, Cosmos Atoms are sent via IBC to Umee and deposited to create uAtoms. The uAtoms are bridged over to Ethereum via Gravity Bridge and will exist as ERC20 uAtoms. Subsequently, the uAtoms can be used for borrowing assets native to the Ethereum blockchain.

There will be two types of collateral tokens:

- **uTokens**
- **meTokens**

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The example detailed above already indicates a uToken. The following section will describe the meToken.

2.2) Staked Borrow Positions - meTokens

Umee will allow the unique ability to collateralize a borrow position using staked assets. As mentioned previously, staked positions can be used in two different ways. A user such as Alice can stake her Cosmos Atoms and use her collateralized staked assets to borrow DAI. She would pay interest on her DAI loan, though will be concurrently earning validator rewards from her staked Atoms.

Bob on the other hand would stake his Atoms and allow his staking rewards to be immediately liquidated for stablecoin. He is able to take out a loan in DAI, though what is unique about his position is that the interest that he would pay on borrowing DAI would be supplemented by the staking rewards that are earned from his staked assets.

Alice

When Alice stakes her assets, she receives a meToken in return. The meToken represents a staked position. When Alice sends her Atoms to Umee, they get staked on a network of Cosmos validators (more on this later). The meToken maps 1:1 with a staked Atom. As the Atom earns staking rewards, the meToken concurrently earns staking rewards in the form of meAtoms that will transfer to a wallet of her choosing. Alice can withdraw her staking rewards whenever she wishes. She can even deposit them back into Umee. In order to unbond she will execute the unbonding process (more on this later) and exchange her meToken for the original principal amount.

Bob

When Bob stakes his assets, he receives a meToken as well. Though Bob chooses a feature where as the staked Atoms earn rewards, the rewards are immediately liquidated for stablecoin. The reason why Bob would do this is if he wishes to borrow stablecoins, he can essentially cancel out the interest that he would pay on the stablecoin loan utilizing the staking rewards from his staked position. For example, if the interest rate to borrow DAI was 6% and his staked Atom was earning 7%, Bob could borrow the DAI for free. He would pay 0% for his loan and earn 1% based on the difference between the DAI borrowing rate and the staking rate that he is earning. On this platform, if Bob chooses not to borrow, he would simply receive his liquidated staking rewards in the form of DAI. Bob can withdraw his staking rewards whenever he wishes. If Bob chooses to unbond, he will go through a similar unbonding process as Alice.

Stake Reward Liquidation

Umee will include features where users of meTokens can choose which asset their staking rewards are liquidated for. For example, Charlie may wish to liquidate his staking rewards for

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USDC instead of DAI. The protocol will allow him to do so when depositing his Atoms and receiving meTokens that he would use as collateral for borrowing.

2.3 Unbonding

In this ecosystem, meTokens need to go through a 21 day unbonding period to unbond the stake. During the 21 day unbonding period, stake is not earned. These tokens are also exchangeable/transferrable when going through the 21 day unbonding event.

When not going through an unbonding event, meTokens are fungible. When meTokens are going through 21 day unbonding periods, they will no longer be fungible with other meTokens nor will they be fungible with meTokens that are going through separate 21 day unbonding periods. When going through the unbonding periods, they can still trade on AMM based exchanges in liquidity pools.

After 21 days have successfully passed after the initiation of an unbonding period, the holder of a meToken will be able to exchange their meToken for an equivalent uToken. Holders of uTokens can immediately withdraw Atoms.

2.4 Validators

When proof of stake assets such as Atoms are deposited onto Umee for creating meTokens they are automatically staked onto validators.

In the initial implementation, Umee will pick the most reputable validators in order to ensure safety from slashing events.

The validators that are used by Umee can be rotated and rebalanced. The selection of validators as well as stake allocation will be determined by voting through the governance token.

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2.5 Slashing

In situations where there is a slashing event, the assets affiliated with the slash are all affected. For example, if Atoms staked onto Umee are slashed, the meToken collateral tokens will also experience the slashing event. A proportional amount of meTokens will be slashed subsequent to the Atoms getting slashed. If there are meTokens that are pegged into Ethereum as ERC 20 tokens, then those too will experience a global burn. This means that ERC 20 versions of meTokens will be burned on the Ethereum side via the two way bridge used to peg the assets. The global burning of ERC 20 tokens on the Ethereum side will likely be managed by the smart contract that issues the tokens. The amount burned on the Ethereum ERC 20 side will be proportional to the amount slashed.

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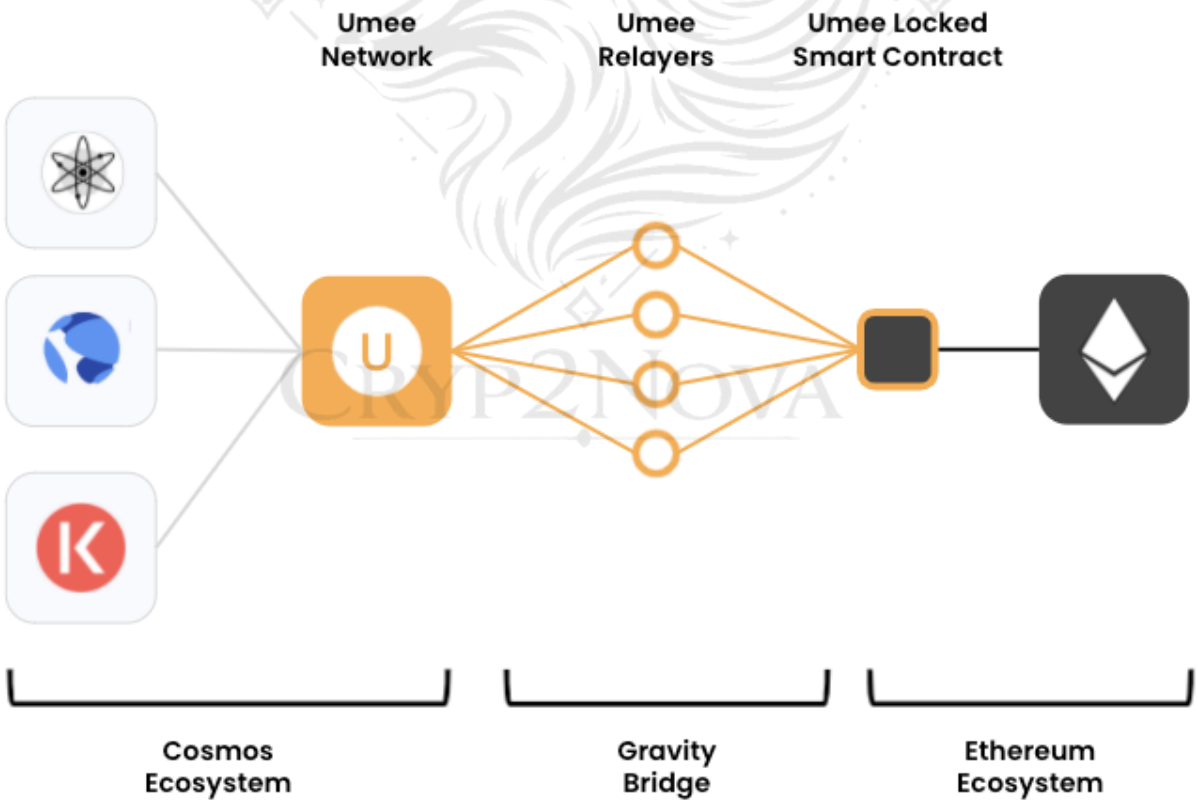
3) Protocol Architecture

The foundation of this protocol will be based on the Umee network. The Umee network will be a protocol that implements a bridging solution for connecting to Ethereum. The mechanism is a core decentralized bridging solution to interoperate between Ethereum and Cosmos, spearheaded by the Interchain Foundation (ICF). Similar solutions have been implemented by various teams including:

- Althea
- SifChain
- Peggy JV
- ThorChain
- Secret Network
- Agoric

The protocol intends to use the Gravity Bridge implementation while optimizing for decentralization and infrastructure tradeoffs.

Figure 3



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The structure of this network will include a set of relayers that relay transactions from the Ethereum blockchain to the Umee network through the Gravity Bridge. Concurrently, as the result of a successful launch of the IBC protocol, the Umee network will be able to transfer tokens between other fast finality chains built on the Cosmos SDK.

Umee intends to create an IBC connection with all fast finality chains that connect to the Cosmos network. Through IBC connections, the Umee network will be able to implement DeFi functionality for assets throughout the crypto ecosystem.

3.1 Umee Bridging Protocols

Umee will initially bridge assets back and forth from Cosmos to Ethereum utilizing the Gravity Bridge. Additionally assets will be bridged between Cosmos SDK based ecosystems utilizing IBC. A combination of these bridging protocols will be used towards optimizing capital flow within the cross chain network.

3.1.1 Technical Architecture - Main functional building blocks needed to implement Umee Protocol:

Gravity Bridge (Messaging Bridge) - a libp2p based gossip network. Monitors network chains for token transfers submits and signs messages across a P2P network. Implements a MultiSig schema and threshold signatures to relay approved messages between chains.

This bridge will be an implementation of the Cosmos<>Ethereum two way bridge. This initial bridge architecture will utilize the Althea Gravity Bridge to be able to transfer Cosmos based assets to Ethereum as ERC 20 tokens via a lock and mint mechanism. These assets will also be able to be transferred back to the Cosmos ecosystem via a burn and unlock mechanism.

Validators in the Umee network will run three main software components when implementing the Gravity Bridge:

1) Gravity Bridge Module integrated into the main Cosmos binary
2) Gravity Bridge Orchestrator
3) Geth light client or any Ethereum full node implementing the JSON-rpc standard

The relay node which connects to both chains, observes lockups and submits multi signatures. Written in pure Go. libp2p - gossip based network; multi sig approvals are used to approve the execution of a specified action on a chain.

- cmd — CLI entry point, deals with the mechanics of parsing command line flags and loading keys.
- processor — Most of the business logic for cross-chain communication lives here. Talks to multiple loosely coupled services communicating via Go channels.
- libp2p — gossip based network.

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- devnet — Constants and helper functions for the deterministic local devnet.
- ethereum — Ethereum chain interface with auto-generated contract ABI. Uses go-ethereum to directly connect to an Eth node.
- cosmos — Light gRPC wrapper around a Go Module
- supervisor — Erlang-inspired process supervision tree
- multi-sig — multi sig approvals are used to approve the execution of a specified action on a chain.

Cosmos Token Modules - Burn and Mint Factories, Alt_IBC_tokens: Atom, BNB, Osmosis, Akash Cosmos_wrappers (AKA Umee_IBC_Tokens)

Ethereum Token Contracts - Burn and Mint Factories, ERC20_Umee_IBC_tokens: Atom, BNB, Osmosis, and Akash ETH_wrappers (AKA ERC20_Umee_IBC_Tokens)

IBC Implementation - The IBC protocol will be used towards bridging assets from other Cosmos based networks onto Umee. This bridge will rely on IBC, a decentralized standardized cross chain communication protocol. This means that assets such as BNB, Osmosis, Akash, and ATOM can be onboarded into the network and locked and minted to create Cosmos based Umee versions. These Umee representations, Umee_IBC_BNB, Umee_IBC_Osmo, Umee_IBC_Akash, and Umee_IBC_ATOM's will be able to participate in DeFi within the Umee zone as well as transferred to Ethereum as ERC 20 tokens.

Network (Umee Network) - A cosmos based network to help facilitate token transfers.

The Umee network is a Cosmos SDK based chain that sits between everything. It will connect to Ethereum via the Gravity Bridge. With the development of IBC, the Umee Network will interconnect with other Cosmod SDK based networks to allow the sending of assets from other blockchains to the Umee network.

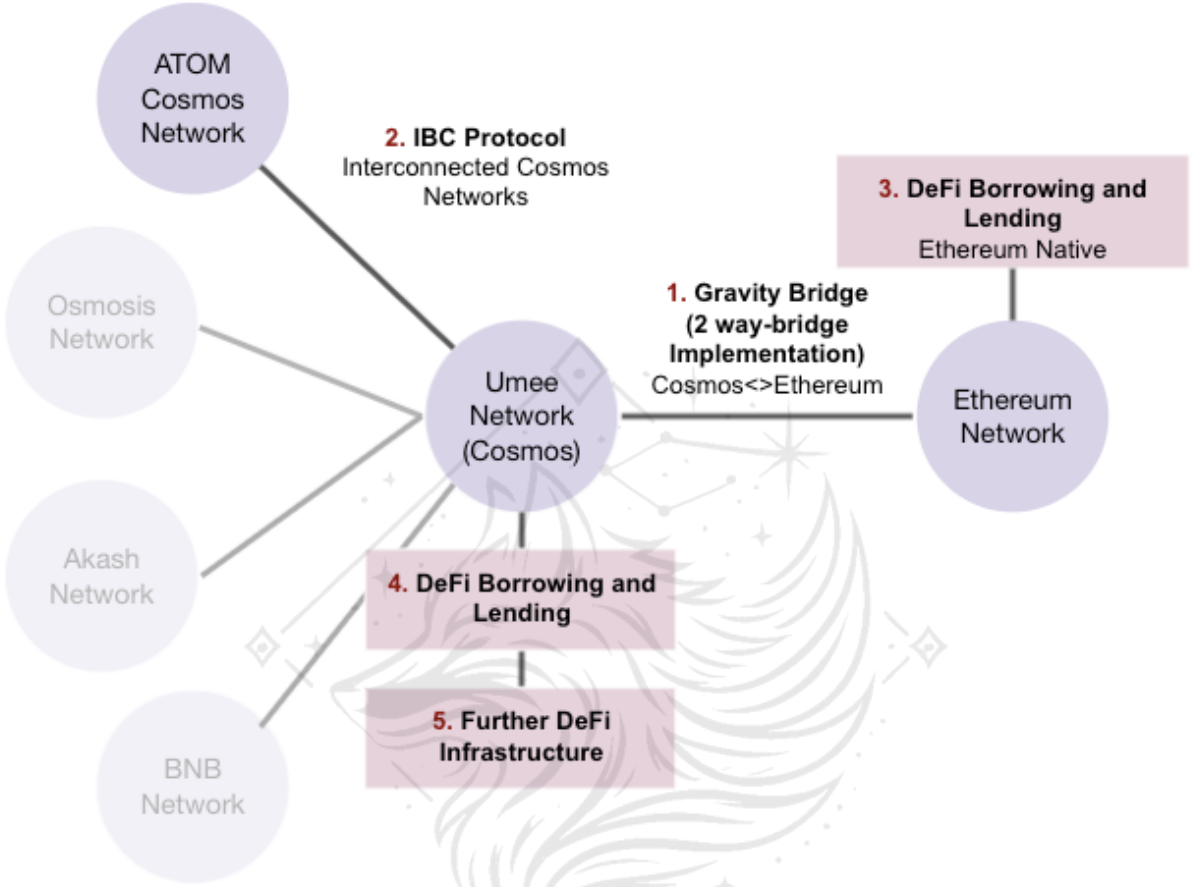
- Built on the Cosmos SDK
- Launched via Starport Network
- Tendermint Consensus
- Validator Proof of Stake
- Relays between the Gravity Bridge

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3.1.2 High Level Architecture

Figure 4



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3.1.3 Umee Network Workflow

Once assets like Atom, BNB, Osmosis, and Akash are sent to the Umee Network, they will be locked and minted as Umee_IBC_Tokens via IBC. These Umee_IBC_Tokens can also be burned and the original asset returned to the original blockchain. IBC transactions will be the basis for how fast finality networks interact with each other.

After assets are in the form of Umee_IBC_Tokens, they can be sent to the Ethereum blockchain via the **Gravity Bridge** where they will exist as ERC20_Umee_IBC_Tokens. These ERC20_Umee_IBC_Tokens can also be burned and the original Umee_IBC_Token will be sent back to the Umee Network.

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3.1.4 Umee DeFi modules

DeFi protocols will be implemented across the Cosmos and Ethereum blockchains. On the Cosmos side, Go Modules will be used for the application layer. The Ethereum side will use traditional solidity smart contracts.

Ethereum Network
A collection of Aave based solidity smart contacts, javascript wrappers, and services.

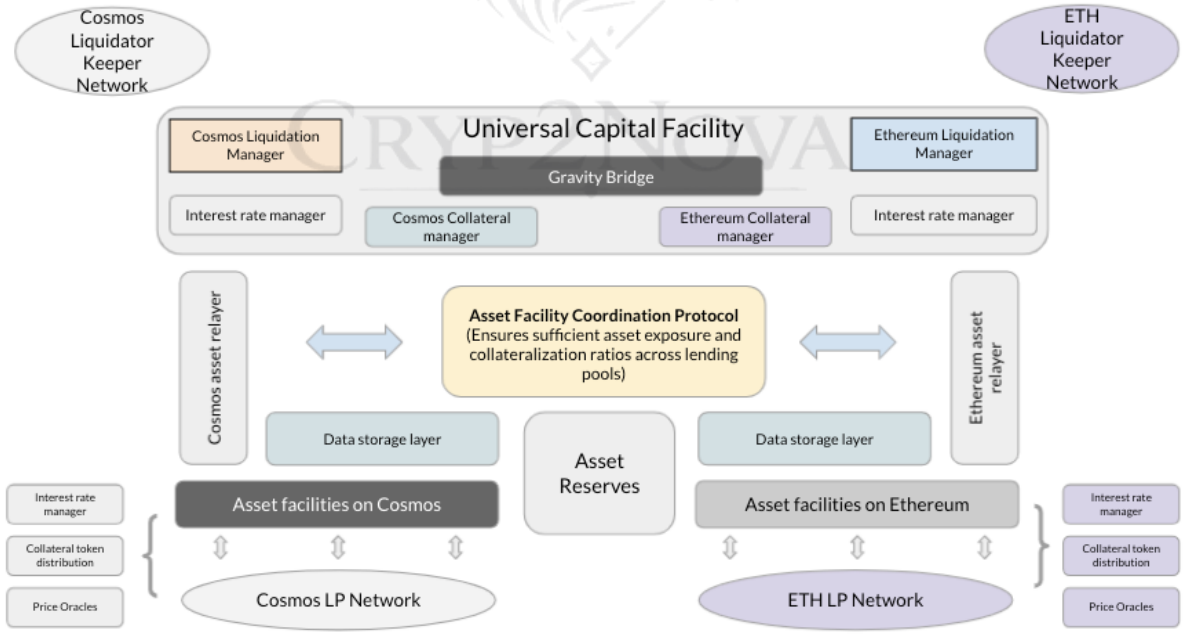
Cosmos Network
A collection of Go Modules and Ethereum DeFi modules for replicating existing protocol interfaces.

3.2 Asset Facility Coordination Protocol

This protocol coordinates actions throughout the Universal Capital Facility. Umee contains depositors, borrowers, liquidity providers and various parameters that need to be kept track of. **AFCP** works to ensure various dynamics:

- Loan to value ratios are kept at healthy levels
- Loans meet a sufficient overcollateralization threshold
- Loans that are under the overcollateralization threshold are sent to the liquidation manager
- Interest rates adjust as a result of changing supply and demand of assets across the capital facilities

Figure 5



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3.3 DeFi Network Components

Components discussed in this section are designed to provide necessary functionality throughout the Universal Capital Facility.

3.3.1 Asset Facilities

These pools receive assets from the various networks. Depositors add assets into the Asset Facilities and earn a rate of interest for their deposit. The Asset Facilities comprise of the assets that will be borrowed by users of the Universal Capital Facility

- Interest rate manager - manage interest rate earned by depositors
- Collateral token distribution - depositors get a token that represents their assets in the asset facilities. The word “asset” and “collateral” can be interchangeable here
    - The tokens are referred as uTokens and meTokens
- Price oracle - checks price of assets

3.3.2 Data storage layer

Gathers data on the assets

- Total assets
- How much assets are lent out to borrowers

Data is relayed by the **Asset Relayers** to ensure that the **Asset Facility Coordination Protocol** is able to properly manage the health of the lending/borrowing ecosystem

3.3.3 Reserve

The reserve is essentially the treasury of Umee. A portion of accrued interest from Borrow Positions as well as from other lending activities are put into the reserve treasury for future use. The reserve is used as emergency/insurance funding for blackswan events.

4) Platform Management

4.1 Lenders

Users can lend assets. Lenders and Liquidity providers can be the same users. They will receive interest based on the asset that they lend. Once lenders deposit assets into the

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Universal Capital Facility, they will receive a uToken collateral token. These uTokens will represent the assets lent as well as the earned interest through lending the assets. Depositors of assets into the Universal Capital Facility will receive ERC 20 compliant uTokens when depositing assets onto the Ethereum side, and IBC based uTokens when depositing assets on the Cosmos side. These uTokens can be transferred between Cosmos and Ethereum via the Gravity Bridge.

4.2 Borrowers

In order to establish any of the borrowing scenarios, sufficient collateral must be deposited to ensure the necessary levels of overcollateralization. uTokens and meTokens will be the collateral used to establish borrowing as they are direct indicators of collateral that is deposited into the **Asset Facilities**.

4.2.1 Normal Borrow Positions

Users will be able to use their uTokens and meTokens as collateral for borrowing assets from the Universal Capital Facility. Users can use the collateral tokens for borrowing any asset deposited on the Universal Capital Facility that has sufficient reserves. This includes both Cosmos as well as Ethereum assets.

4.3 Collateral Management

Collateral Manager protocols keep track of collateral affiliated with Borrow Positions. They will ensure that the LTV ratios are sufficient to ensure overcollateralization of the Capital Facility network. Borrow Positions will have diversified collateral.

4.3.1 Borrow Position Collateral Management

Collateral management in this system will be determined by the underlying health factors of the pools that users borrow from. Because some assets are more volatile or have lower market caps than others, higher levels of overcollateralization will be necessary for opening Borrow Positions with them.

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4.4 Liquidation Managers

Liquidation Managers initiate the process of moving assets into an auction market where keepers can choose to auction for undercollateralized Borrow Positions.

4.4.1 Borrow Position Liquidations

If the LTV's fall below the necessary threshold of overcollateralization, Liquidation managers will receive instructions from Collateral Managers to begin the process of selling assets on the open market. Assets will sell at a heavy discount to incentivize immediate purchase. Borrowers can prevent this process by adding additional collateral tokens in order to ensure healthy overcollateralization.

5) Implementation

5.1 Deposit

Depositing involves a user who has assets and who wishes to deposit the assets into the Universal Capital Facility to either earn interest or borrow assets.

1. User sends assets to Umee address
2. Asset gets sent to their respective Asset Facility
3. Updates the state on both chains
4. Oracle reads asset price and updates the state to the **Asset Facility Coordination Protocol**
5. Assets are sent to the Universal Capital Facility
6. Interest rate manager indexes are updated to determine rate paid out to depositor
7. Equivalent uTokens are minted and sent to the user.
    a. uTokens are the collateral token
8. Assets will remain in the Universal Capital Facility until:
    a. Assets are redeemed
    b. Assets are liquidated due to liquidation event
    c. Assets are lent out to borrowers

5.2 Borrowing assets

This section will detail a general process for how these are executed.

5.2.1 Borrow Position

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1. User chooses assets to borrow
    a. Price oracle checks asset prices
    b. Asset Facility Coordination Protocol checks existing assets in the Capital Facility
2. Asset Facility Coordination Protocol checks users balance of uTokens as collateral
3. User deposits uTokens into the collateral managers
4. Interest rate manager index updates to reflect borrowed amount
5. Collateral manager monitors health of the Borrow Position
6. User receives lent assets

5.3 Repay

Users are able to repay their Borrow positions. This section details the mechanisms.

5.3.1 Normal Borrow Positions

Users will be able to repay their debt back into the protocol.

1. User elected to return some of their borrowed amount back
2. Asset Facility Coordination Protocol checks price of assets from Borrow Position via an oracle
3. Interest rate manager index checks final interest owed
4. User returns borrowed assets plus interest owed (in the form of the asset borrowed)
5. Borrowed asset is returned to the Universal Capital Facility
6. uToken collateral is unlocked and returned back to the user

5.4 Redeem

A redeem action occurs when the user wishes to redeem a portion of their collateral from the Universal Capital Facility.

1. User elects to redeem their uToken collateral for the original crypto
    a. Keep in mind, the uToken has been constantly generating interest as the user has been holding the uToken. The uToken experiences inflation based on the prevailing interest rate manager index
2. **Asset Facility Coordination Protocol** checks how much asset to exchange for the uToken
    a. **AFCP** also refers to a price oracle
3. User receives collateral asset on their respective blockchain
4. The uTokens are burned

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5.5 Liquidate

Liquidations occur when the collateral of a normal Borrow Position are undercollateralized due to a decrease in the asset price of the collateral.

5.5.1 Borrow Position liquidation

1. Asset Facility Coordination Protocol checks the health of Borrow Positions
    a. Price oracles are used to determine price
2. It is determined that collateral in a Borrow Position is under collateralized
3. The Interest rate manager reads the interest rate manager index in order to determine the final interest owed
4. The collateral is auctioned off by a Liquidation Manager
5. Liquidators/Keepers survey the network for auctions. They are the ones who bid on the auctions to buy the collateral assets.
    a. They are able to purchase the assets at a significant discount to the market price
6. Liquidators/Keepers are able to use a combination of cryptocurrencies to pay for the collateral assets
    a. Auctions will start at market price of the collateral asset and slowly decrease in price
        i. The goal of the auction is to liquidate the collateral asset at as low of a price as necessary inorder to generate enough income to pay back the Borrow Position plus interest
        ii. Any remaining collateral asset that exists subsequent to the auction is returned to the borrower in the form of the collateral asset.

6) Interest Rates

6.1 General Interest rate dynamics

Interest rate dynamics are heavily influenced by market conditions. Liquidity providers and depositors earn an interest rate when depositing assets into the Capital Facility. The interest rate for each asset is algorithmically determined based on a number of factors:

- Supply/demand
- Historical volatility
- Trade volume and market cap
- Total liquidity and Utilization rates of the total liquidity

This interest will be generated as uTokens which will be constantly inflating.

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6.1.1 Base Rate

There is a base rate that represents the cost to borrow regardless of the existing utilization of the platform. The base rate can be voted on and affected by governance. All other factors such as supply, demand, and utilization exist subsequent to the base rate and will be added to the base rate to determine a final interest rate. The base rate applies to all depositors into the Universal Capital Facility.

$$R_{base} = \frac{\sum_{i=1}^{n} lendingRate_i \, borrowVolume_i}{\sum_{i=1}^{n} borrowVolume_i}$$

The base rate takes a market average of the rates on other borrowing and lending platforms to determine what initial rate depositors should receive for initially lending an asset on Umee. Governance will determine which market borrowing and lending platforms will be used towards determining this market average.

6.1.2 Utilization

Algorithmic interest rates are used to determine interest based on supply, demand, and utilization. Utilization is defined as the amount of assets used for borrowing on the platform.

$$\mu(t) = \frac{borrowPositions(t)}{borrowPositions(t) + availableDeposit(t)}$$

Based on prevailing risk factors applied to the platform, Umee will conduct an overall assessment of credit factors and generalized assessment of health ratings in order to determine target utilization rates.

$$\mu_{target} = f(t)$$

In situations where the utilization rate is below the target utilization rate, Umee will adjust the overall borrow rate for more favorable borrowing conditions. When utilization rate exceeds the target utilization rate, borrowing rates will adjust upwards to reflect a premium for the heavy demand.

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6.2 Borrow Position Interest rates

The **Borrow Positions** will have no maturities. The interest rate will be determined by the algorithmically determined floating interest rates of the protocol. Interest rates are algorithmically determined for the borrower as well as lenders. Borrowers will pay back interest in the form of the tokens they borrowed.

Some assets are more volatile than others and have less liquidity or market cap. Therefore the interest rate determined from some assets will be higher for others. The final borrow rate, R_{borrow} will be a function of the utilization rate which takes into consideration the R_{base} as well as μ_{target} for determining supply and demand dynamics.

$$R_{borrow}(t) = f(\mu(t))$$

The rate that depositors can expect to receive is based on the final borrow rate R_{borrow}.

$$R_{deposit}(t) = \mu(t) * R_{borrow}(t)$$

6.3 Credit Rating

Loan positions will have a credit rating to determine their overall solvency and health. If loans are below a certain over collateralization ratio, they will be considered for liquidation. Umee will determine a comprehensive credit rating system for all assets supported.

7) Token Economics

The UMEE token will empower community governance of the protocol. Users will be able to delegate, debate, propose, and vote on changes to the overall platform. Users will be able to submit proposals for actions such as adding support for new assets, changing collateral factors, adjusting interest rates, or other various parameters.

8) Conclusion

Umee combines the functionality of a cross chain lending protocol with ability to leverage staked assets. In this Universal Capital Facility users will be able to participate in new capital relationships across DeFi projects.

Umee is designed as a universal lending and borrowing hub for assets to be leveraged across blockchains. By creating borrowing and lending relationships between chains, the network can

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help facilitate interoperability among various systems. The eventual goal will be to become a hub of activity, similar to a decentralized World Bank where assets on one blockchain can be used for interacting with assets on another blockchain.

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