Polar Path: The Architecture

Enabling a Parachain Token to be usable on Ethereum requires a multi-step setup phase, in which we do the following:

1. An individual or entity deploys an ERC-20 contract token on Ethereum with a fixed supply based on parachain needs.
2. The individual or entity disables its token issuer rights on the ERC-20 contract.
3. Registration of the ERC-20 token on AssetHub by this or any other entity.
4. The entity holding ERC-20 funds performs a one-time transfer of all tokens from their Ethereum account to the parachain's sovereign account on AssetHub.
5. Parachain governance recognizes the ERC-20 wrapper by enacting pairing of the ERC-20 token to the native currency in the Polar-Path pallet and disables the circuit breaker.
6. Switching is now enabled and available to all holders of the native token on the parachain.

After the setup phase, the flows enabled are the following (and presented below):

1. Transmit parachain tokens, lets call it "PARA", from parachain to wPARAs on AssetHub via XCM
2. Send wPARAs from AssetHub to the ERC20 contract on Ethereum via Snowbridge
3. Send wPARAs from the ERC20 contract on Ethereum to AssetHub via Snowbridge
4. Transmit wPARAs on AssetHub to PARAs on the parachain via XCM

The process results in an ERC20 wrapper token around the parachain native token, which is transferable on AssetHub, Ethereum, and any connected EVM chain. Allowing for greater utility and providing access to the token for Ethereum Users through a trustless bridge.

Below are some high-level diagrams of how the different flows are achieved.

Flows

1) PARA -> wPARA on AssetHub

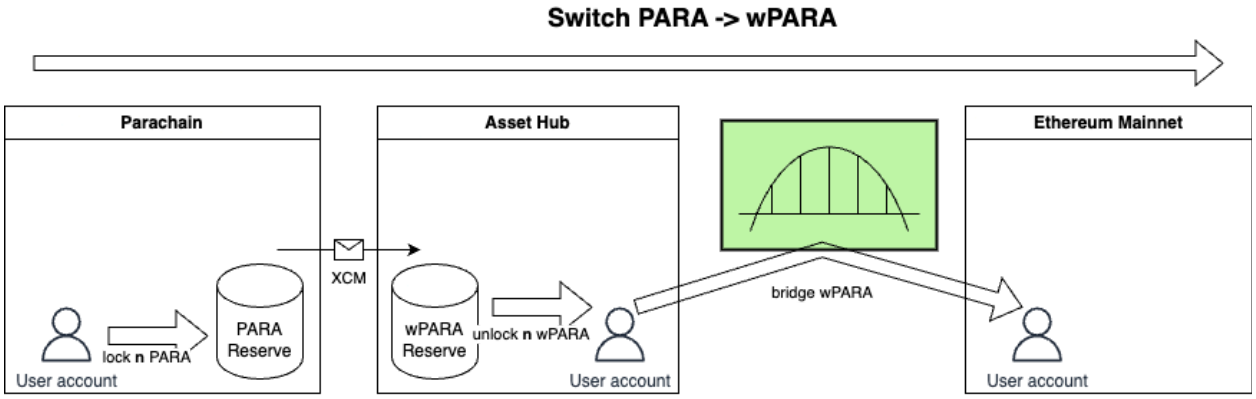
This flow represents the operation of locking PARAs to send wPARAs on AssetHub.

Prerequisites

- The user has to have enough PARAs to pay for the tx fees on the parachain.
- The user has to have enough DOTs to pay for the XCM fees on AssetHub and still be left with at least the existential deposit of 0.01 DOTs.

Flow

1. The flow starts with the user interacting with the parachain to convert PARAs to wPARAs on AssetHub.
2. The parachain will move and lock the selected number PARAs from the user's account to the reserve location.
3. The parachain then sends an XCM message to AssetHub, moving the amount of wPARAs from the parachain account to the user's account.



RESULT

The user has locked the selected amount of PARAs, increasing the balance of the wPARA reserve location on the parachain. On AssetHub, the parachain's sovereign has transferred this exact number of wPARAs to the user's account.

2) wPARA on AssetHub -> wPARA on Ethereum

This flow represents the operation of sending some wPARAs from AssetHub to Ethereum via the Snowbridge bridge.

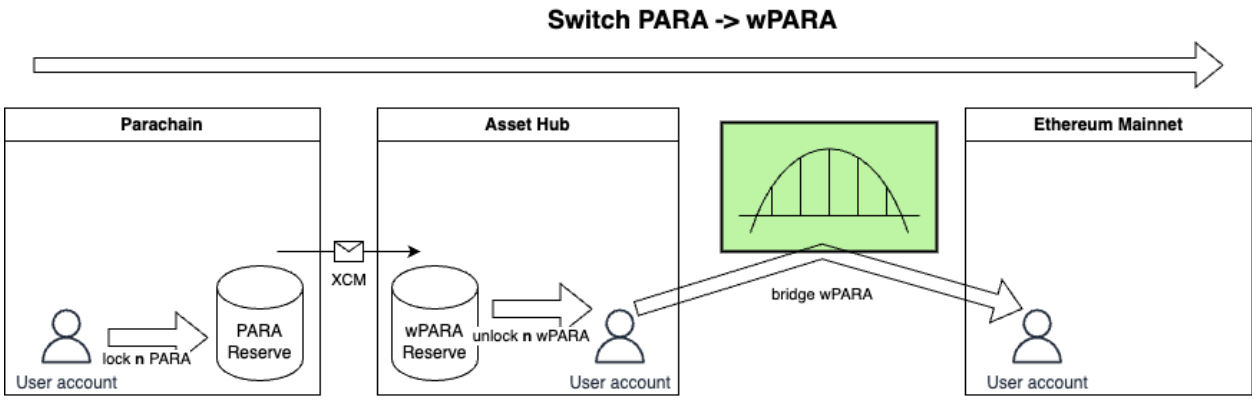
Prerequisites

- The user must have enough DOTs to pay for the AssetHub tx fees + XCM fees to BridgeHub + Ethereum bridging fees (also in DOTs) and still be left with at least the existential deposit of 0.01 DOTs.

Flow

1. The flow starts with the user interacting with AssetHub and calling the extrinsic to transfer a selected number of wPARAs to Ethereum.
2. This will trigger a withdrawal of this amount of wPARAs from the user's account on AssetHub.

3. The transfer is then propagated from AssetHub to BridgeHub and from BridgeHub to Ethereum via the relayer network.
4. Upon receiving the message, the gateway contract will perform the transfer of wPARAs from the reserve account to the user's account.



RESULT

No changes to the parachain' sovereign account, since this account is not involved in the operation. The user has moved wPARAs they controlled on AssetHub to Ethereum, to an account of their liking.

3) wPARA on Ethereum -> wPARA on AssetHub

This flow represents the operation of sending some wPARAs from Ethereum to AssetHub via the Snowbridge bridge.

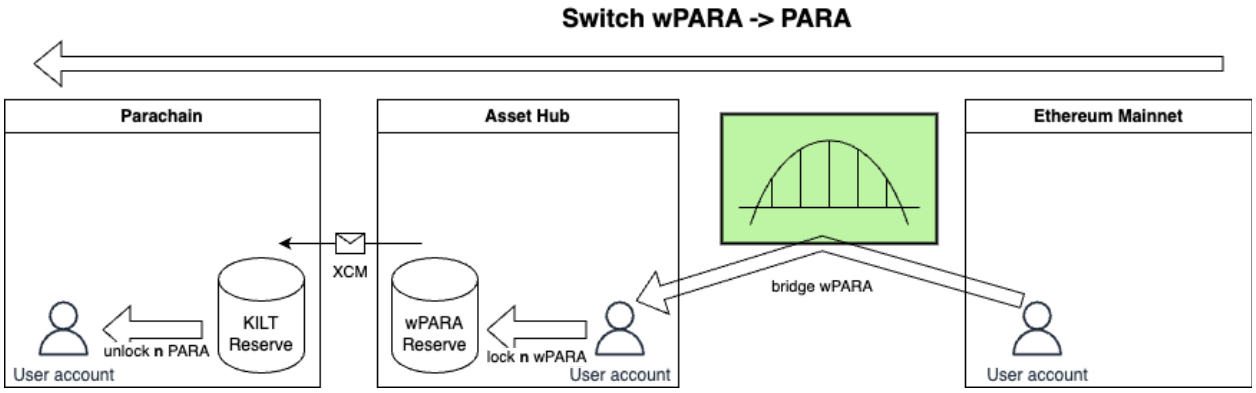
Prerequisites

- The user must have enough Ethers to pay for the bridging operation
- The user must have at least the existential deposit on AssetHub (0.01 DOTs).

Flow

1. The flow starts with the user interacting with the Snowbridge gateway smart contract on Ethereum. They specify how many wPARAs must be bridged, and to what destination address, on AssetHub.
2. The Snowbridge gateway smart contract moves the wPARAs from the user's balance to the reserve account, effectively removing those wPARAs from circulation on Ethereum.

3. The balance transfer operation is then propagated by the bridge.
4. Once it reaches AssetHub, the corresponding amount of wPARAs is credited to the specified user's account.



RESULT

The user has moved wPARAs they controlled on Ethereum to AssetHub, to an account of their liking.

4) wPARA on AssetHub -> PARA

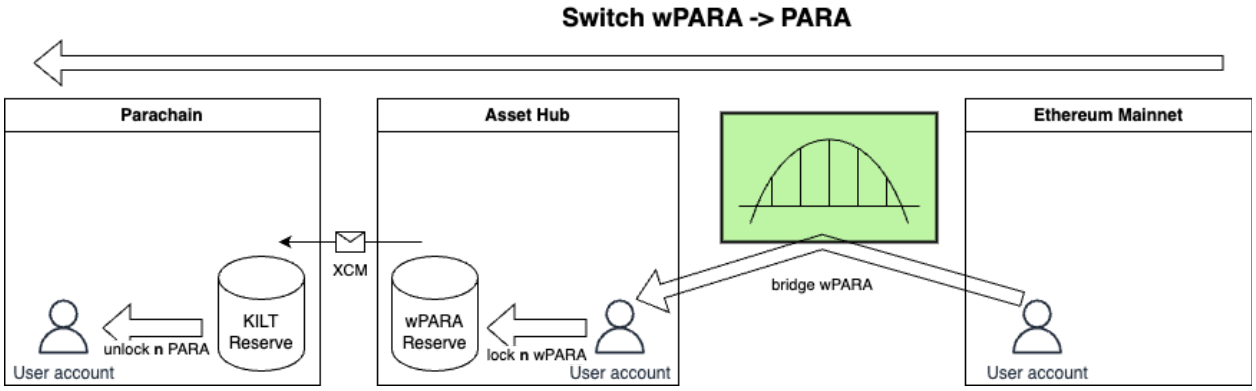
This flow represents the operation of performing a reserve-based transfer of wPARAs to the parachain sovereign account on AssetHub in order to receive an equivalent number of PARAs on the parachain.

Prerequisites

- The user has to have enough DOTs to pay for the XCM fees on AssetHub and still be left with at least the existential deposit of 0.01 DOTs.
- The user has to have enough wPARAs to pay for the tx fees on the parachain.

Flow

1. The flow starts with the user interacting with AssetHub.
2. The operation results in AssetHub transferring wPARAs from the user's account to the parachain's sovereign account on AssetHub.
3. AssetHub then sends an XCM message to the parachain, indicating that the user has indeed transferred a certain amount of wPARAs to the parachain's sovereign account. This signals the parachain that it can release this amount of PARAs from the reserve account and must send them to the User's account on the parachain.



RESULT

The user has switched some wPARAs on AssetHub with some PARAs on the parachain, that have been taken from the special reserve account.