Free TON On-line Auctions

Contest submission by OCamlPro

Contact: Fabrice LE FESSANT @fabrice_dune

1 Introduction

This document will describe the submission proposed by the OCamlPro team for solving the DevEx contest on on-chain auctions. The goal of this contest was to provide smart-contracts (SC) for deploying and managing different type of auctions (English & Dutch) with multiple variations (Forward, Reversed & Blind). These SCs must be compatible with TON's Crystals, TIP3 & DePools. Also, they must be written in Solidity or C++, the FreeTON SC's languages.

The code of our submission is available on Github:

https://github.com/OCamlPro/freeton_auctions/

2 Contributions of this submission

Our submission is in two complementary parts, `first-version/` and `second-version/`

Note that a "classical error" is to implement reverse auctions as a simple change in the direction of auctions, i.e. English auctions are moving up, while Reverse English auctions are moving down. Instead, reverse auctions also reverse the position of buyers and sellers. We did this error in the first-version/ (so we do not claim implementation of reverse auctions in that part), but correctly implemented them in the second-version/ (but we didn't have enough time to finish that version with debot and testing).

2.1 Part first-version/

This part contains:

- A set of smart contracts in Solidity implementing various flavors of on-line auctions:
  - An `AuctionRoot` contract used to easily deploy the different auction flavors
  - An `EnglishAuction` contract
  - A `DutchAuction` contract
  - `Bid` and `BlindBid` contracts to bid in these auctions

All these auctions work on a generic interface for TIP-3 tokens described in the `IVault` interface.
- Deployment scripts using `` `ft` ``, our FreeTON wallet for developers, to test the contracts
- A formal specification of each auction in TLA+ (tla+/)
- A high-level specification in an UML fashion (spec/)
- A debot for interacting with the SC framework (contracts/debot/)

with the following limitations:
- Limited checks on accesses to public methods of contracts
- Reverse counterparts of the different flavors of auctions are incorrect, because the buyers and the sellers have not been reversed

2.2 Part second-version/

This part complements the first-version/ part with a focus on:
- Using direct TON transfers and standard TIP-3 tokens (we used Broxus TIP-3 token contracts)
- In the “direct” flavor, the winner (buyer) “wins” control over the auction smart contract, allowing him to control the “merchandise” for the auctioneer (seller), usually, another TIP-3 token wallet. No specific method is used to bid, a simple transfer is used to bid both for TONs and TIP-3 tokens.
- In the “reverse” flavor, the winner (seller) receives the tokens (TONs or TIP-3 token) from the auctioneer (buyer), while the “merchandise” (another TIP-3 token) is transferred from his bid contract vault to the auctioneer vault. Note that the bidder can only start bidding after transferring his merchandise to the bid contract vault, so that the merchandise is in an “escrow”.
- Particular attention has been paid on access control

The following flavors have been implemented in this model:
- English auctions (with min-increment percentage)
- Dutch auctions in automatic mode : the price decreases automatically with time
- Dutch auctions in manual mode : the price is decreased manually by the “auction house”
- Reverse English auctions

Limitations:
- No debot
- No deployment

3 Details on the first-version/ part

3.1 Auction specification

We divided the six auctions into three categories, English, Dutch, which can either be Forward or Reverse and Clear (by default) or Blind. The logic behind each auction is described in the TLA+ files.

English Forward: the auction is initialized with a *starting price*, a *max tick* (time unit) and a *max time* (time unit). The auction always end when *max time* is reached. As long as no bid is done, nothing happens. When a bid is done, the auction ends after *max tick* without any other bid **higher** than the last one (or if *max time* is reached).

English Reverse: same than English Forward, except a new bid must be **lower** than the last one.

Dutch Forward: the auction is initialized with a *starting price*, a *limit price*, a *price delta* and a *time delta* (time unit). The *bidding price* is a function of the time spend since the beginning of the auction, the *price delta* and the *time delta*. After each *time delta*, the bidding price is **decremented** of *price delta* until it reaches *limit price*. If the price reaches *limit price*, the auction ends after *time delta*. If anyone bids a value **higher** than the *bidding price*, he automatically wins the auction.

Dutch Reverse: same than Dutch Reverse, except the *bidding price* is **incremented** and the auction ends when anyone bids a value **lower** than the *bidding price*.

Blind auctions work the same way as a **Clear** auctions, except the commitment is hidden until validation of the bidder.
These auction definitions hare the pleasant property that they **eventually ends**, either with or without a winner. Also note that the difference between a Forward & Reverse auction is quite small. The SC implementation takes into account this similarities to limit their size.

3.2 Infrastructure

Here is the list of the main contracts (including their interface) with a short description.

AuctionRoot: the main contract of the infrastructure ; this contract will deploy the auctions and the bid managers.

BidBuilder: the bid manager ; an instance of this contract is built when an auction is created and will be in charge of creating Bid contracts and validating bids.

Bid: the bid contract ; when a user wants to bid to an auction, the auction sends a request to its BidBuilder to create a new Bid – this Bid is in charge of checking the status of a generic “Vault” contract. If the status of the “Vault” is correct, then the Bid is valid and tells the BidBuilder that it is correct.

ReverseBid : the bid for reverse auctions

BlindBid : the bid for blind auctions

VEnglishAuction: the logic behind any English auction ; this abstract contract encodes the bidding process of an English Auction with a virtual function *newBidIsBetterThan*.

VDutchAuction: the logic behind any Dutch auction ; this abstract contract encodes the bidding process of an Dutch Auction with a virtual function *betterPriceThanCurrent*.

Constants : defines miscellaneous constants, modifiers and events used through the project.

The actual Auction contracts are defined in *EnglishAuction.sol, EnglishReverseAuction.sol, DutchAuction.sol* and *DutchReverseAuction.sol*. They inherit their respective abstract contract (*VEnglishAuction* or *VDutchAuction*) and only define the virtual function (*newBidIsBetterThan* or *betterPriceThanCurrent*).

Few more interfaces are defined. These contracts have no static implementation and must be defined by the Auctioneer.

IVault: a contract holding the bidding funds. When a bid is done, the user must satisfy the “Vault” constraint (for example, transferring a given amount of crystals on its balance). The funds on the “Vault” are locked and managed by the Bid contract ; this last contract will either send it back to the Bidder if he lost the auction or to the Auctioneer if he won.

IRootWallet: the manager of Vaults. They define a function *getWalletAddress* that returns a Vault address (mostly used for TIP3 compatibility)

IProcessWinner. a contract that should only be called by an auction. It has two functions: *acknowledgeWinner* and *acknowledgeNoWinner* that are respectively called when there is a winner / there is no winner.

3.3 Description of the Auction process

The file *spec/bid_diagram.pdf* describes the different steps of an auction.

3.3.1 Auction deployment

The auctioneer defines a Winner Processor. In Forward auctions, the auctioneer will sell the contract ownership while in Reverse auctions, he simply provides the contract code he wants to take control of. Then, he deploys an auction through the AuctionRoot contract. AuctionRoot deploys 2 contracts : the Auction & its associated BidBuilder. The Auctioneer then must initialize the BidBuilder with the address of the Auction (this step could be avoided by calculating in advance the auction address). The Auction can then be started.

3.3.2 Bidding process

Any user can commit a bid by calling the *bid* function of an Auction. The Auction requests the BidBuilder to create a Bid contract. This Bid contracts emits the details of its associated Vault (in Forward, a vault is created for every contract while in Reverse, there is a single vault containing the auctioneer funds). The user then transfers funds to the Vault (Forward) or deploys a winner processor contract (Reverse); when this is done, the bidder asks to check the correctness of the bid. If it is correct with respect to the Bidder's commitment, Bid validates its status to BidBuilder, who checks the origin of the validation. If the validation comes from a correct Bid contract, it transfers the validation to the Auction. The Auction has now a new bid, the potential old bid transfers back its vault to the previous bidder.

3.3.3 Ending an auction

3.3.3.1 Auction winner

The function *acknowledgeWinner* is called with the best bidder information (address, amount, Bid address & Vault address) by the auction. The Vault content is transferred to the Auctioneer (Forward) or the buyer (Reverse).

3.3.3.2 No winner

The function *acknowledgeNoWinner* is called.

4 Details on the second-version/ part

The second-part/ implements on-line auctions with the following properties:

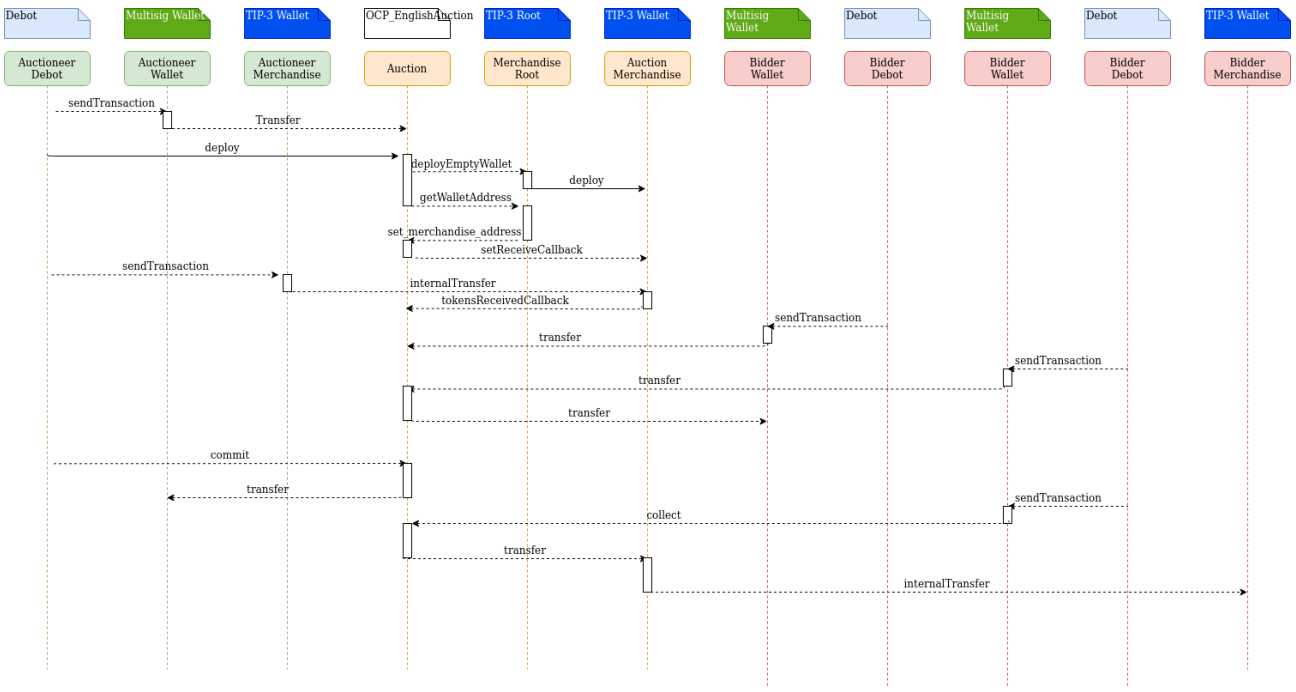
- The merchandise being sold is represented by a quantity of TIP-3 tokens, stored in vaults during the bidding process. In the "direct" flavors, the ownership of the auction contract is transferred to the winner, so that other merchandises may be sold, as long as ownership of the contract grants full access to such merchandises
- The "money" used is either TON crystal, or any TIP-3 token. We used Broxus contracts in our implementation. During "direct" auctions, a bid is done by simply transferring the money to the auction contract (or its wallet for TIP-3 tokens).
- For "reverse" auctions, the auctioneer (buyer) transfers his money to the auction wallet at the beginning of the auction. Bidders create AuctionBidder contracts, a vault (TIP-3 wallet) is attached to every such AuctionBidder where the bidder must

store his merchandise before being able to bid. In case of win, the merchandise is transferred to the auctioneer vault, while the auctioneer's money is transferred to the winner.

4.1 Example: The Direct English Auction

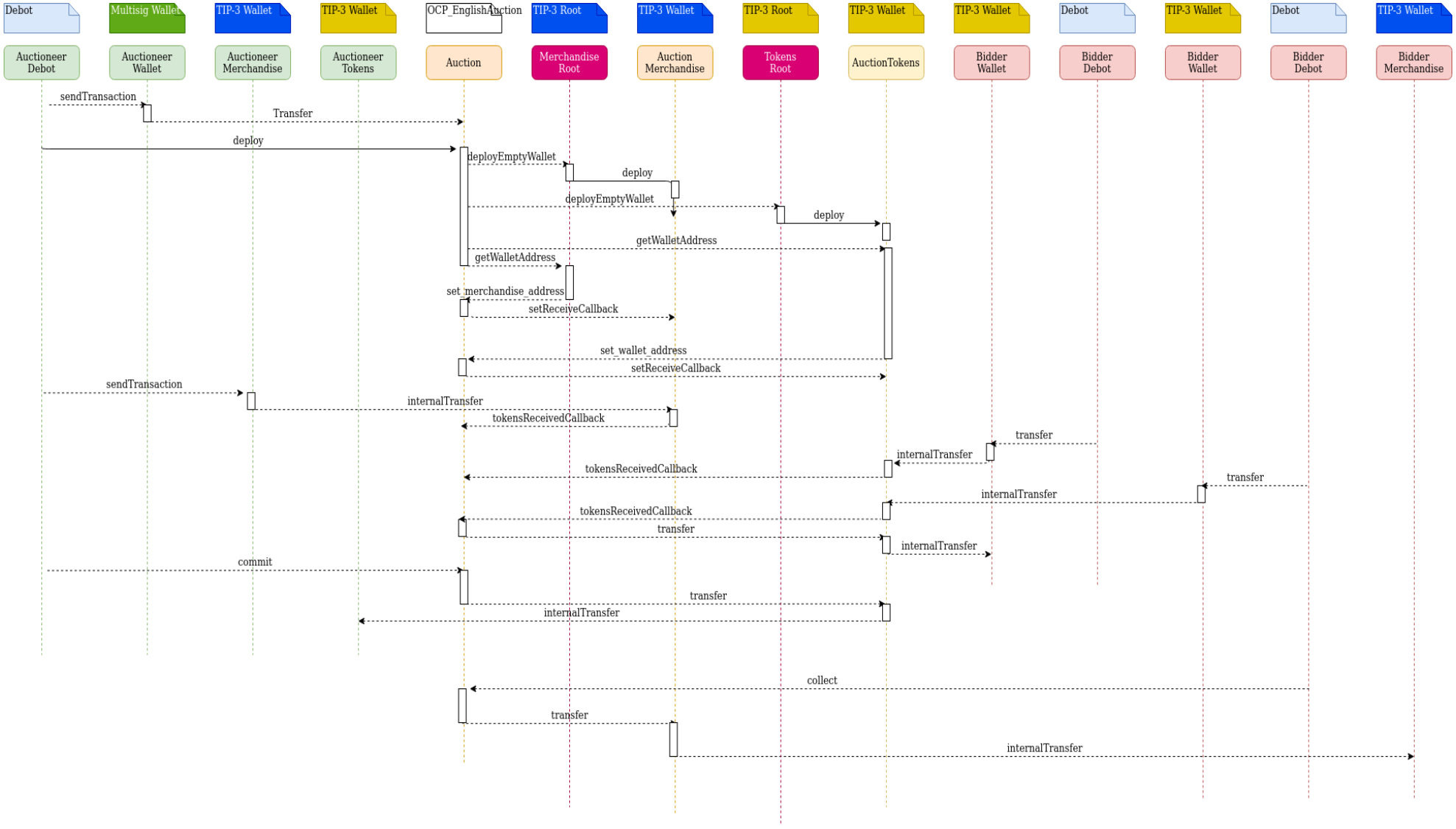
The next picture represents all the messages sent during a Direct English Auction done with fiat (TONs):

- In the first part, the auctioneer deploys the auction contract (we plan to simplify this process by either providing a root contract for auctions, or simply using a debot).
- In the picture, the contract would create a vault where the auctioneer would transfer the merchandise, however, in the current implementation, we didn't implement that step, and just transfer ownership of the auction contract to the winner. Thus, the contract implements a sendTransaction function, à la Multisig, so that the winner can forge and send any message originating from that contract, for example to ask for a transfer of the merchandise. We think this approach is more generic, but will still implement the vault for merchandise also.
- In the next step, a first bidder transfers TONs to the auction from his multisig. The bid is accepted (if greater than the minimal price set by the auctioneer)
- In the second step, another bidder transfers TONs to the auction. Since the bid is bigger (if wanted, the contract can check for a minimal bid increment, like 10%), it is accepted, and the former bidder is immediately refunded
- Finally, when the auction is finished (the auctioneer can set a maximal time, or a delay after the last bid), a commit() message can be send by the owner to transfer the bid money to his account; The winner is now owning the contract and can use it to send messages to other contracts. In the picture, we propose to implement a collect() message in the specific case of a TIP-3 merchandise that has been stored in the auction vault.



Note that, although the picture is for an English Auction, the difference with a Dutch Auction is minimal: in the case of a Dutch auction, the first bid is the winning bid if it is greater than the current price, so there would be only one bidder in the scenario, and no need to refund a previous bidder or wait for the end of the auction.

In the second picture, we present the same Direct English Auction, but using a TIP-3 token as money. The interactions are a little more complex, because every entity must own a TIP-3 wallet and use it to transfer/receive the bids.


Debot
Multisig Wallet
TIP-3 Wallet
TIP-3 Wallet
OCP_EnglishAuction
TIP-3 Root
TIP-3 Wallet
TIP-3 Root
TIP-3 Wallet
TIP-3 Wallet
Debot
TIP-3 Wallet
Debot
TIP-3 Wallet
Auctioneer Debot
Auctioneer Wallet
Auctioneer Merchandise
Auctioneer Tokens
Auction
Merchandise Root
Auction Merchandise
Tokens Root
AuctionTokens
Bidder Wallet
Bidder Debot
Bidder Wallet
Bidder Debot
Bidder Merchandise
sendTransaction
Transfer
deploy
deployEmptyWallet
deploy
deployEmptyWallet
deploy
getWalletAddress
getWalletAddress
set_merchandise_address
setReceiveCallback
set_wallet_address
setReceiveCallback
sendTransaction
internalTransfer
tokensReceivedCallback
transfer
internalTransfer
tokensReceivedCallback
transfer
internalTransfer
tokensReceivedCallback
transfer
internalTransfer
commit
transfer
internalTransfer
collect
transfer
internalTransfer

4.2 Auction Smart contracts

The following pictures describes the inheritance relationship between the different smart contracts that we implemented: