Transaction Processing Unit in a Solana Validator

TPU (Transaction Processing Unit) is the logic of the validator responsible for block production.

Transactions are encoded and sent in QUIC streams into the validator from clients (other validators/users of the network) as follows:

- The quic streamer: allocates packet memory and reads the packet data from
- the QUIC endpoint and applies some coalescing of packets received at
- the same time. Each stream is used to transmit a packet. And there is limit on the
- maximum of QUIC connections can be concurrently established between a client
- identified by (IP Address, Node Pubkey) and the server. And there is a limit on the
- maximum streams can be concurrently opened per connection based on the sender's
- stake. Clients with higher stakes will be allowed to open more streams within
- a maximum limit. The system also does rate limiting on the packets per
- second(PPS) and applied the limit to the connection based on the stake.
- Higher stakes offers better bandwidth. If the transfer rate is exceeded,
- the server can drop the stream with the error code (15 -- STREAM_STOP_CODE_THROTTLING).
- The client is expected to do some sort of exponential back off in retrying the
- transactionswhen running into this situation.
- sigverify stage: deduplicates packets and applies some load-shedding
- to remove excessive packets before then filtering packets with invalid
- signatures by setting the packet's discard flag.
- banking stage: decides whether to forward, hold or process packets
- received. Once it detects the node is the block producer it processes
- held packets and newly received packets with a Bank at the tip slot.
- broadcast stage: receives the valid transactions formed into Entry's from
- banking stage and packages them into shreds to send to network peers through
- the turbine tree structure. Serializes, signs, and generates erasure codes
- before sending the packets to the appropriate network peer.Previous Anatomy of a Validator Next Validator Blockstore