BCXP: Blockchain-Centric Network Layer for Efficient Transaction and Block Exchange over Named Data Networking.

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Summary.

Blockchains are a well-known technologies that enable our transactions be clear and transparent. That is why, in all the paper, the authors did not even mention what a blockchain is. And I will take that liberty too.

From the title, we will note something quite out of it: blockchain-centric. And if you thought about a blockchain that is centralized, you are right. But it will be quite interesting to check out what the results were by pushing the IP overlay protocols to the limit compared with others blockchain architectures.

While trust-less systems ideas were widely considered around the world, and are even implementing these, there's no doubt that blockchain is still a impractical substitution for trustful systems. The establishment from the IP based overlay network of a logical topology of peers delays due to traffic redundancy, and becomes increasingly more complex as the number of peers increase.

So, this article provides an alternative to the IP overlay networking: building a blockchain-centric network on top of a Named Data Networking (NDN).

Let's have an overview of the BCXP architecture. It can be divided into three layers: the NDN layer, the Content Oriented Publish/Subscribe System (COPSS) and the BCXP Namespace, ordered from the lowest one.

In the first layer is where the addressing and routing is implemented.

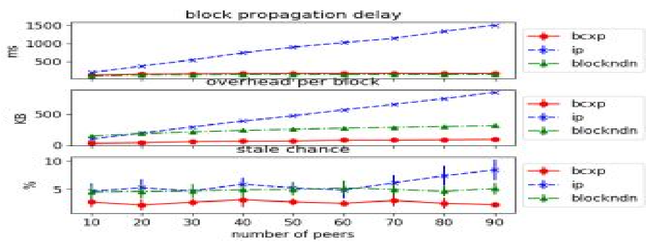
NDN allows blockchain data to be propagated in a request-response way, where a data package corresponds to only one interest packet. Routers can avoid a kind of saturation of interest packets by collapsing them into a Pending Interest Table, and then routers replicate the data packet to satisfy all outgoing interfaces, implementing also client multicasting.

But this is not enough work for the first layer of the model. This is because receivers are not aware of blocks and transactions generation times. But in a publish/subscribe model, where receivers would have to subscribe to namespace they are interested in, as soon as transactions are produced, they are broadcasted to the subscribers. So, this is implemented within the second layer of our model.

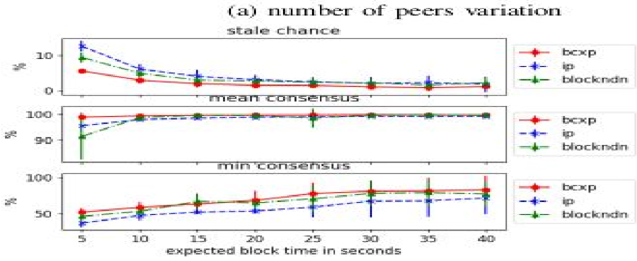
For last, we have to define the blockchaining operations. This will be covered in the last layer of this mode, which define a hierarchical namespace divided into two transfers mode: a live mode, and a fetch mode, and both two will be defined later.

We need to talk a bit more about the second layer (COPSS) and its two new packet types: the subscribe packet and the publish packet. The first uses a Subscription table, which is similar to a Pending Interest Table (used in a interest/data model) but

a single subscribe packet corresponds to an arbitrary number of publish packet (in a interest/data model, a interest packet corresponds to one data packet). Publish packets are similar to data packets and they are sent by the producers.
Also, COPSS requires the introduction of a Rendezvous
Node (RN), acting as a root of the subscription tree and
responsible for one or multiple content prefixes. Any COPSS-
aware router can act as an RN and multiple RNs can be used at
the same time. This is why I thought they called it a centric blockchaining but it is still unclear (for me) with multiple RN acting as a central peer in local regions. Is that still called centric? Is not something like semi-centric?
As I mentioned before, in the namespace we have to transfer modes: the live one and the fetch one, and we can differentiate them with how the blocks and transactions are generated and obtained. In a live mode, these are propagated as soon as they are generated, while in a fetch mode old transactions and blocks are obtained from “full nodes”. This allow to multiple blockchains utilize the same network concurrently.
For the evaluation of the BCXP, the authors used simulations that were built in a Rocket Fuel 3967 network topology, and compare the results of this simulation with a IP overlay network and a BlockNDN. This were the metrics taken in account:
• Block propagation delay: time taken for a block to reach all peers.
• Overhead per block: traffic per link due to propagation of a single block.
• Stale block chance: the ratio of stale blocks committed to the length of the longest chain (fork chance).
• Mean consensus: the average percentage of peers in consensus during a simulation run.
• Min consensus: the minimum percentage of peers in consensus in a simulation run (worst case 50%).
I would have to add this graphics in order to save a lot of text (not laziness, just taking advantage of visual tools):



(a) number of peers variation



(b) expected inter-block time variation

In conclusion, as we were expecting, the results showed, in this metrics, that a BCXP architecture may be better as other well known architecture in blockchain systems. There are still question that are not even questioned in this paper: the first one, are these metrics enough to the BCXP to substitute classical architectures? It may be not the case, but it would be interesting showing the disadvantages of this model and contrast it with others. But, even in this case, it is interesting how a new architecture can be better at some metrics than the actual used models for blockchaining. This is part of the nowadays building of new state of the art technologies, so it is not in vain that papers like this come in. The second question is, what about the scalability of this blockchain layer? In my opinion, even with better results, the scalability problems are not solved. It is still a unpractical substitution for the actual trustful systems. But it is not the way the authors concluded. In my four-articles experience, the authors do not conclude the way they should. There are many questions open and still in the air that are not trivial, not to mention that these are not related to the main problem or need (scalability of blockchain). For the rest, it is a good article and showed me what can I expect from the IEEE Conferences on Local Computer Networks, and also a lot of other terms that even I, who had been studying blockchaining and coding theory have not heard of it.

References:

Sedky, G., & El Mougy, A. (2019). BCXP: Blockchain-Centric Network Layer for Efficient Transaction and Block Exchange over Named Data Networking - IEEE Conference Publication. Retrieved from https://ieeexplore.ieee.org/document/8638229