DOES MUNILAND *REALLY* NEED THE BLOCKCHAIN?

I. HOW THINGS WORK TODAY
II. HOW THE BLOCKCHAIN WORKS
III. HOW TODAY'S THINGS MIGHT WORK AS BLOCKCHAIN THINGS
IV. A REAL LIFE EXAMPLE!
V. DO WE REALLY NEED THIS?

But, first, a story…

…about goat gonad transplants. (Seriously!! I can't make this s&%* up!!)

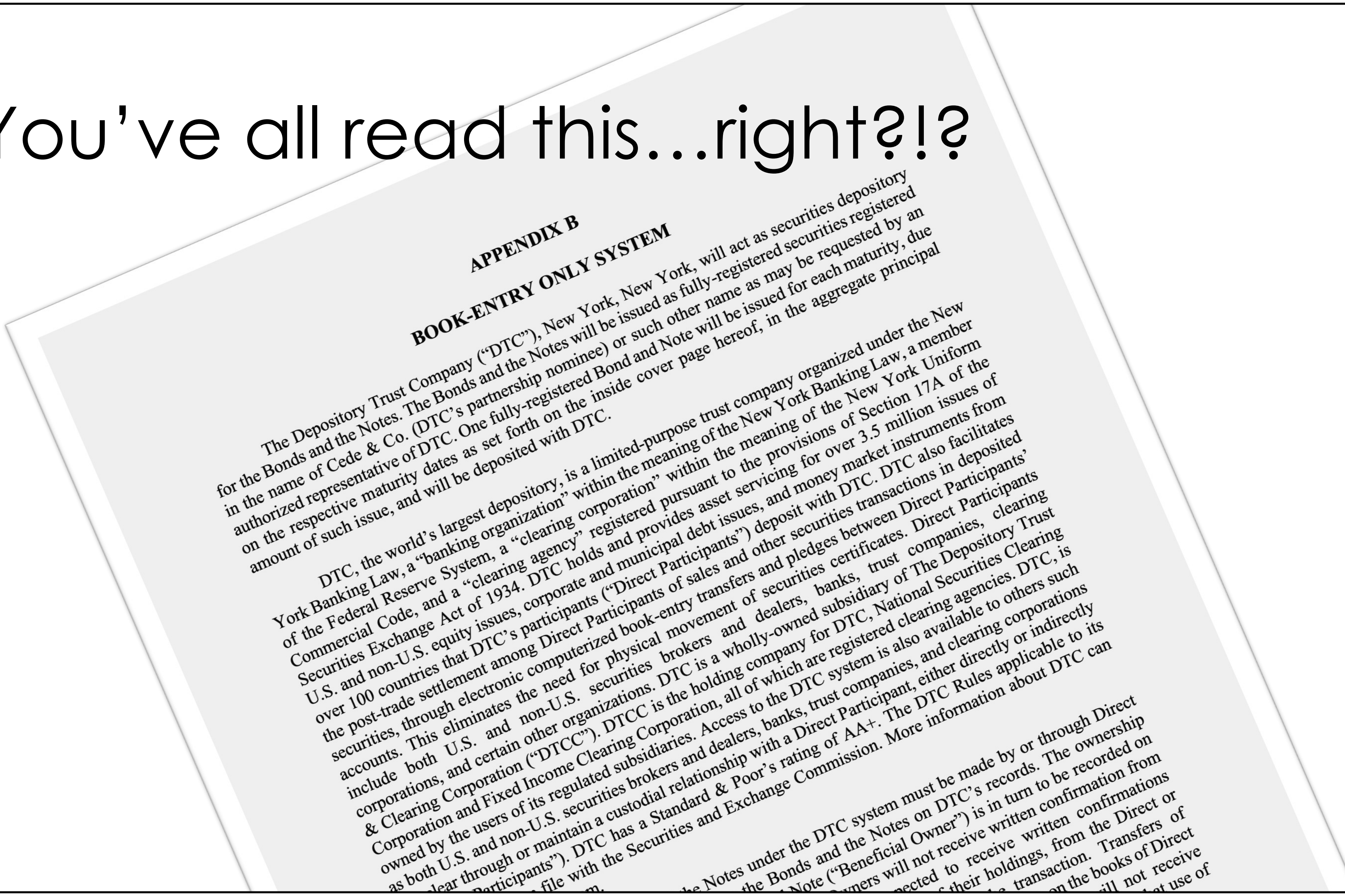
"Brinkley became known as the 'goat-gland doctor' after he achieved national fame, international notoriety, and wealth through the xenotransplantation of goat testicles into humans. Although Brinkley initially promoted this procedure as a means of curing male impotence, **he later claimed that the technique was a virtual panacea for a wide range of male ailments**. Brinkley operated clinics and hospitals in several states and was able to continue practicing medicine for almost two decades, despite his techniques being thoroughly discredited by the broader medical community."

—*Wikipedia*

"Suffice it to say he was a fraud of the first class, **that the goat gland method was bogus**, and that Brinkley probably killed dozens of patients on the operating table."

—*Kansas Reflector*, October 2020

You've all read this…right?!?


APPENDIX B

BOOK-ENTRY ONLY SYSTEM

The Depository Trust Company ("DTC"), New York, New York, will act as securities depository for the Bonds and the Notes. The Bonds and the Notes will be issued as fully-registered securities registered in the name of Cede & Co. (DTC's partnership nominee) or such other name as may be requested by an authorized representative of DTC. One fully-registered Bond and Note will be issued for each maturity, due on the respective maturity dates as set forth on the inside cover page hereof, in the aggregate principal amount of such issue, and will be deposited with DTC.

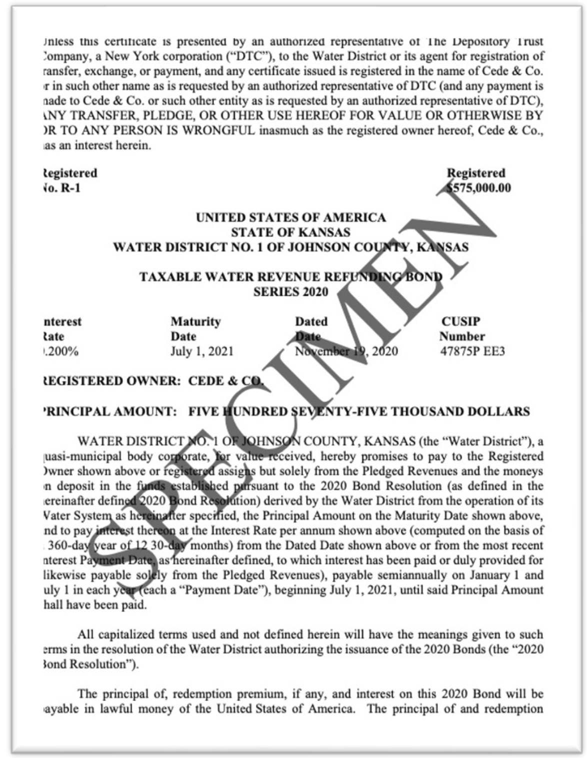
DTC, the world's largest depository, is a limited-purpose trust company organized under the New York Banking Law, a "banking organization" within the meaning of the New York Banking Law, a member of the Federal Reserve System, a "clearing corporation" within the meaning of the New York Uniform Commercial Code, and a "clearing agency" registered pursuant to the provisions of Section 17A of the Securities Exchange Act of 1934. DTC holds and provides asset servicing for over 3.5 million issues of U.S. and non-U.S. equity issues, corporate and municipal debt issues, and money market instruments from over 100 countries that DTC's participants ("Direct Participants") deposit with DTC. DTC also facilitates the post-trade settlement among Direct Participants of sales and other securities transactions in deposited securities, through electronic computerized book-entry transfers and pledges between Direct Participants' accounts. This eliminates the need for physical movement of securities certificates. Direct Participants include both U.S. and non-U.S. securities brokers and dealers, banks, trust companies, clearing corporations, and certain other organizations. DTC is a wholly-owned subsidiary of The Depository Trust & Clearing Corporation ("DTCC"). DTCC is the holding company for DTC, National Securities Clearing Corporation and Fixed Income Clearing Corporation, all of which are registered clearing agencies. DTCC is owned by the users of its regulated subsidiaries. Access to the DTC system is also available to others such as both U.S. and non-U.S. securities brokers and dealers, banks, trust companies, and clearing corporations that clear through or maintain a custodial relationship with a Direct Participant, either directly or indirectly ("Indirect Participants"). DTC has a Standard & Poor's rating of AA+. The DTC Rules applicable to its Participants are on file with the Securities and Exchange Commission. More information about DTC can

…the Notes under the DTC system must be made by or through Direct … the Bonds and the Notes on DTC's records. The ownership … Note ("Beneficial Owner") is in turn to be recorded on … Owners will not receive written confirmation from … pected to receive written confirmations … their holdings, from the Direct or … transaction. Transfers of … on the books of Direct … will not receive … at use of

No? Okay. Fine…

Depository Trust Corporation…who??

- World’s largest depository
- A banking institution under NY law; member of the Federal Reserve
- Holds physical certificates for >3.5MM issues of stock, munis, corporate bonds and money market instruments
- Has direct relationships with its Direct Participants (investment banks, clearing agencies)
- Facilitates secondary market transfers of securities among Direct Participants using electronic means, avoiding transfers of physical stock and bond certificates



Jnless this certificate is presented by an authorized representative of The Depository Trust Company, a New York corporation (“DTC”), to the Water District or its agent for registration of ransfer, exchange, or payment, and any certificate issued is registered in the name of Cede & Co. r in such other name as is requested by an authorized representative of DTC (and any payment is nade to Cede & Co. or such other entity as is requested by an authorized representative of DTC), ANY TRANSFER, PLEDGE, OR OTHER USE HEREOF FOR VALUE OR OTHERWISE BY OR TO ANY PERSON IS WRONGFUL inasmuch as the registered owner hereof, Cede & Co., has an interest herein.

Registered No. R-1 | **Registered $575,000.00**

UNITED STATES OF AMERICA
STATE OF KANSAS
WATER DISTRICT NO. 1 OF JOHNSON COUNTY, KANSAS

TAXABLE WATER REVENUE REFUNDING BOND
SERIES 2020

Interest Rate	Maturity Date	Dated Date	CUSIP Number
.200%	July 1, 2021	November 19, 2020	47875P EE3

REGISTERED OWNER: CEDE & CO.

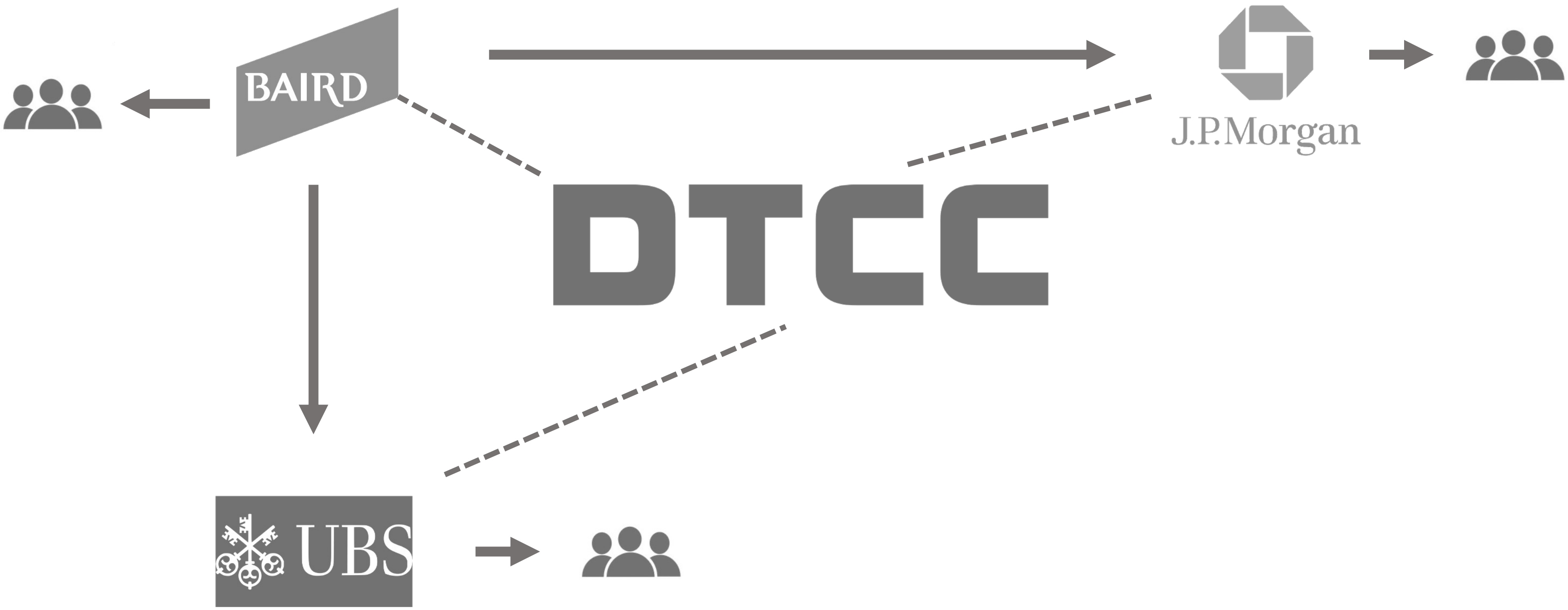
PRINCIPAL AMOUNT: FIVE HUNDRED SEVENTY-FIVE THOUSAND DOLLARS

WATER DISTRICT NO. 1 OF JOHNSON COUNTY, KANSAS (the “Water District”), a quasi-municipal body corporate, for value received, hereby promises to pay to the Registered Owner shown above or registered assigns but solely from the Pledged Revenues and the moneys on deposit in the funds established pursuant to the 2020 Bond Resolution (as defined in the hereinafter defined 2020 Bond Resolution) derived by the Water District from the operation of its Water System as hereinafter specified, the Principal Amount on the Maturity Date shown above, and to pay interest thereon at the Interest Rate per annum shown above (computed on the basis of a 360-day year of 12 30-day months) from the Dated Date shown above or from the most recent Interest Payment Date, as hereinafter defined, to which interest has been paid or duly provided for likewise payable solely from the Pledged Revenues), payable semiannually on January 1 and July 1 in each year (each a “Payment Date”), beginning July 1, 2021, until said Principal Amount shall have been paid.

All capitalized terms used and not defined herein will have the meanings given to such terms in the resolution of the Water District authorizing the issuance of the 2020 Bonds (the “2020 Bond Resolution”).

The principal of, redemption premium, if any, and interest on this 2020 Bond will be payable in lawful money of the United States of America. The principal of and redemption

Book-Entry-Only Magic



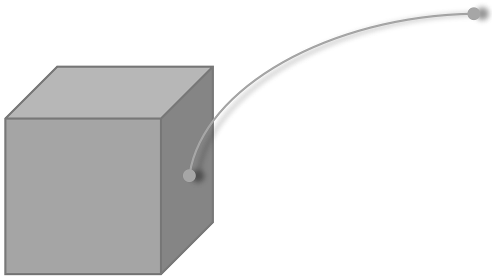
Today: Key Points

- A trusted system with DTC as the key trusted party
- Investors have accounts with DTC Direct Participants (i.e., brokerages)
- Direct Participants have accounts with DTC
- DTC holds the original bond (one per maturity) and keeps track electronically of which Direct Participants own pieces of each original bond
- It is possible to query DTC to see which Direct Participants own a bond but it is generally *not* possible to know which individual investors are Beneficial Owners of a bond

Today: Drawbacks

- DTC, as the trusted intermediary, is a single-point of failure for the system
- The system is quite opaque past the Direct Participant level
- It's impossible to know who the Beneficial Owners are (unless they have mandatory reporting requirements)

All rise for the blockchain… ooooohhhh!



Hash
The SHA256 hash of the text below is:
3b506f0b365c29a2007f1094a69dfc02d246eb46b658c86f38eaf0d8f5**2b1191**

No, not the, “Hey, Barn, there’s hash in these brownies,” hash. In cryptography, a hash is a mathematical function that takes a piece of input (of any length/size) and converts it to a fixed-length output string.

Running in the shadows…

Hash: 2b1191

Previous Hash: 2b1191
New Hash: c4f2c9

No, not the, “Hey, Barn, there’s hash in these brownies,” hash. In cryptography, a hash is a mathematical function that takes a piece of input (of any length/size) and converts it to a fixed-length output string.

Barney Miller Text +
Listen to the wind blow, watch the sun rise/
Running in the shadows, damn your love/
damn your lies/
And if you don't love me now /
You will never love me again

I can still hear you saying/ That you would never break the chain

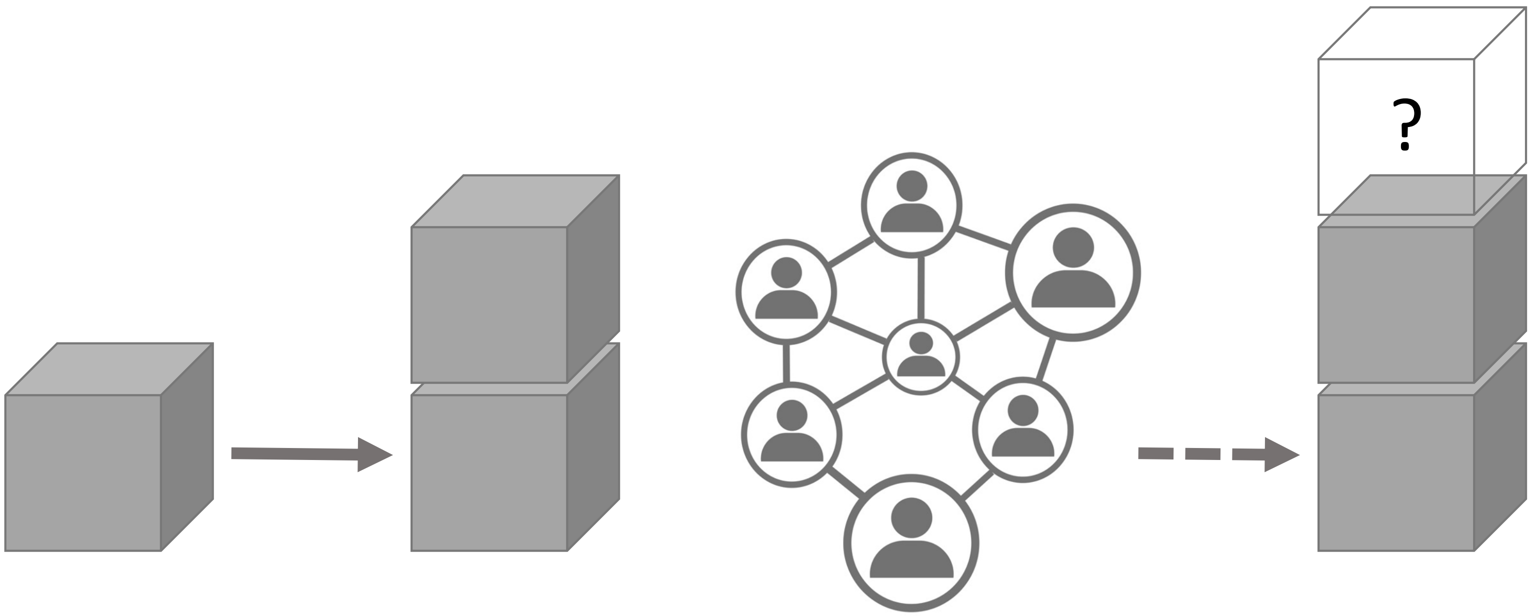
Hash: 9daf97

Please stop with your late ‘70s cultural references already.

Previous Hash: 2b1191
New Hash: c4f2c9

Barney Miller Text +
Listen to the wind blow, watch the sun rise/
Running in the shadows, damn your love/
damn your lies/
And if you don't love me now /
You will never love me again

Practical Byzantine Fault Tolerance



A blockchain is a “distributed ledger technology.” If there’s no central trusted party, we have to rely upon the various nodes, each of which hosts a complete copy of the distributed ledger, to verify and validate new blocks in the chain.

Blockchain ≠ Cryptocurrency

Cryptocurrency is the vehicle

(this might be you…)

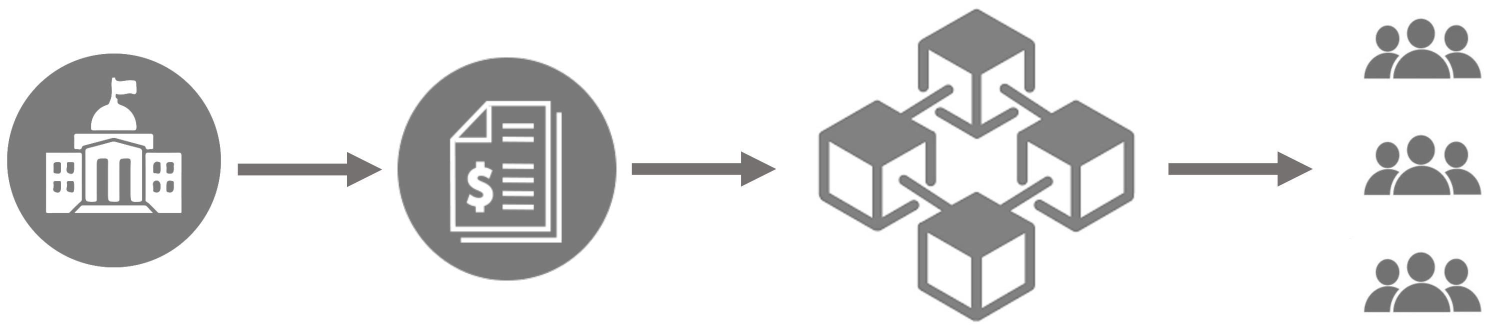
Blockchain is the road

“The” blockchain isn’t really a thing…

Public Blockchain	Private Blockchain
Decentralized (not controlled by single entity)	Centralized (controlled by a single entity)
Permissionless (no restrictions on who can participate)	Permissioned (access by invitation only)
Bitcoin, Ethereum	Hyperledger (Linux Foundation), Quorum (JPMorgan)

Similarities Between the Two Kinds of Chains
Immutable records (append-only ledger)
Each network node has full copy of the ledger
Validity of records is verified cryptographically
Edits require numerous users to authenticate

Hello, Muni. Meet Blockchain.



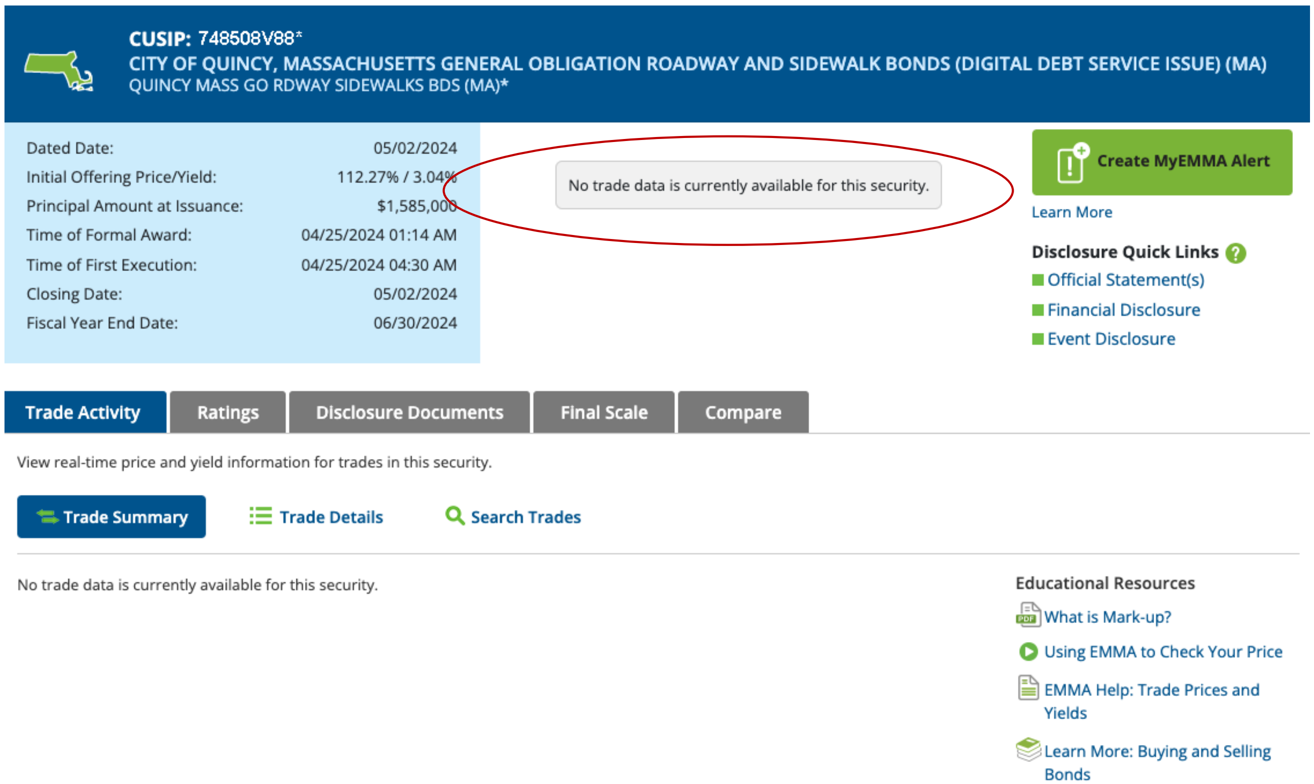
Surely you can't be serious.

- I am serious. And stop calling me Shirley.
- Starting in 2019, the City of Berkeley started working on a "tokenized" version of a bond issue
  - Each bond denomination would be a form of cryptocurrency
  - The tokens would trade on public blockchains (such as Ethereum)
  - City Council voted as recently as Dec 2021 to proceed
  - It doesn't appear it has executed on this financing
- More recently, new entrants are planning to a private blockchain to facilitate muni issuance (among other types of muni financing contracts)

Including a recent example!

- City of Quincy, Mass
  $9,615,000 GO Roadway and Sidewalk Bonds
  May 2024 (final CUSIP 748508V88)
- "Delivery of the Bonds will be made to investors in book-entry form through the 'Digital Debt Service,' an application provided by J.P. Morgan Securities LLC on Onyx Digital Assets, **a private, permissioned blockchain-based platform** operated by JPMorgan Chase Bank, National Association."
- Interestingly, the "global bonds" are held by JPM in trust, **not** on the blockchain
- "investors must have a Securities Custody Account with JPMorgan Chase Bank, National Association to participate in this offering."

Quincy's Transparency Black Hole



What does Quincy make better?

- Errrr….
- DTC is replaced by JPM
- Investors must maintain with JPM (a) a blockchain account, (b) a regular brokerage account, (c) and a regular bank account to participate
- The controlling records are the paper ones held by JPM, not the ones on the blockchain
- Investors can only see *their* holdings on the blockchain, not the holdings of other investors

Tomorrow: Key Points

- Theoretically, a trustless system without a single point of failure
- A much more direct connection between issuer and bondholder
- Potential to build an entire bond issue as a "smart contract"
- Possible to directly trace each bondholder from issuance using the hash-tracing that underpins the blockchain
- More efficient: smaller denominations, no underwriters, no trustees/paying agents, no DTC, no CUSIPs

Ah, yes. But now for the practical realities…

- What problem are we trying to solve?
  - Yes, the current book-entry-only system is based upon trust of an intermediary (DTC)…but is that really a problem?
- Whose chain?!?!
  - We could certainly use a public blockchain, but do we want to? (Search Wikipedia for "The DAO")
  - New companies in the space are touting using a private blockchain, but how is a permissioned system with a private company hosting a private blockchain better than a permissioned system with a trusted party owned by its participants at the center??
- Ours is not an industry that is particularly happy dealing with change

Useless predictions

- Blockchain will be coming to a borrower near you
  - First implementations will be in purchasing, driven by vendors
    - Agencies will be added to private blockchains to provide information about/assure provenance of critical supplies
  - Second implementations will be the next step in board packet creation and/or administrative actions routing
    - If you think about it, the approval processes embedded in modern ERP systems are not too far away from what the blockchain proposes to offer
- High-profile cryptocurrency disasters (I'm looking at you, SBF) have probably already created significant headwinds for muni-via-blockchain implementation…but the new SEC seems to like crypto, so who knows??

Takeaways

- Keep an open mind about how borrowers can use blockchain implementations (likely, private ones) to protect records, assure authorizations and interact with vendors
- Keep in mind that blockchain aficionados will see everything as a nail against which to smack their blockchain hammer
  - But like every technology, the chain only works where it works
- Don’t spend a lot of time worrying about your next bond deal being “on chain”
  - And consider pushing back against “worst of both worlds” approaches as with the Quincy structure

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