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# Blockchain in Healthcare

**APEX** DATA  
SOLUTIONS

Bob Calco, *Chief Architect & Lead Developer*

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**VA**



**U.S. Department of Veterans Affairs**

Veterans Health Administration  
National Artificial Intelligence Institute



# Bob Calco

## *Chief Architect and Lead Developer*

Mr. Calco is a seasoned enterprise architect and a proven software innovator with over 20+ years of experience designing, building and leading teams to deliver large-scale, enterprise solutions in the healthcare, financial services and retail sectors. For the past 5 years, Mr. Calco's work has focused on data sharing and interoperability both within and between large distributed enterprise systems. Mr. Calco was the primary visionary and architect for the VistA.js Platform within the VA, a Class 1 enterprise microservices framework that enabled data federation and reconciliation across the VA's 154 medical centers. That experience now drives his vision behind Apex's *Unify!* and *DomainMaster*, and their use of scripting in support of distributed microservices for sharing data across systems and even organizational boundaries. He is leading the Apex Team utilizing these technologies to address current industry challenges associated with Provider Data Management/Provider Directories.

Mr. Calco is a certified expert in multiple programming languages, having worked productively in over a dozen programming environments and platforms as diverse as C++, Delphi, Ada, Java, .NET (C#, VB), JavaScript, LISP, Clojure, Scala, Smalltalk, Ruby and others.



# Debunking the Key Blockchain Misconception

- Over the past 5 years blockchain has become synonymous with “distributed ledger” (or hyperledger) implementations.
- Blockchain is NOT a ledger (or hyperledger), rather a ledger is one of many possible implementations of a blockchain.
- The ledger-based paradigm has been successfully implemented in areas such as crypto currencies, financial transactions, supply chain management and claims billing and processing.
- However, to date, the ledger-based paradigm has not been successfully implemented to support health care data exchange or enterprise interoperability. And for good reason: it’s the wrong metaphor for sharing data!

# At Its Core, What is Blockchain

- Blockchain is an algorithm for verifying data integrity over a handful of applicable data structures. It is not a solution, but elements of a solution depending on your engineering goals.
- More precisely: Blockchain verifies data integrity in a sequentially ordered list-like structure (for example, that it has not been tampered with or modified) by linking list elements with a hashing strategy.
- Blockchain also verifies two or more copies of the same list are identical by reference to the hash of the last element in the list, because it depends on the hash of every preceding element, in order.

# Does Blockchain Have a Future Role in Solving Enterprise Interoperability?

- We need to stop taking a hammer & nail approach by insisting that the ledger-based paradigm must be part of any enterprise interoperability solution.
- Because the ledger-based paradigm imposes a smart contract/tokenized/monetization model, it adds complexity and overhead to many enterprises rather than simplifying their data management and exchange needs.
- As an architect and technologist, I believe we should not succumb to an implementation bias, rather we must identify what blockchain concepts best support customer needs and their enterprise environments to determine what value, if any, blockchain-enabled solutions may offer.

# Re-Imagining Blockchain in Healthcare

- As discussed, the ledger concept, most often associated with blockchain implementations, doesn't quite fit the clinical aspect of healthcare data or healthcare data exchange.
- The ledger is an accounting concept. You are looking at transactions in exchange for value and it's certainly one way to look at data exchange. However, I don't think that is the key metaphor for broader utilization in health care.
- Instead, a more accurate way to think of this in a healthcare context is that it's more about a journal of events of things that have happened, things that we can see over time and track; this is where the immutability of blockchain data structures is essential because you have a certain understanding about a sequence and timing of events.

# How We Got Here

- We came to blockchain in healthcare through work we did for the VA. As the Prime Contractor, we delivered a Class 1 microservices framework to be deployed at each VA medical center that enabled clinicians to federate and reconcile patient data across multiple instances of VistA.
- As part of that work, we demonstrated that you could introduce change at a specific VA medical center and propagate it to the other instances of VistA in near-real time.
- This microservices framework was designed to support any number of Enterprise Shared Services (such as Scheduling) as well as Clinical Applications such as Medication Reconciliation (MedRec). In delivering a MedRec prototype, we had a number of interesting requirements over and above the federating data across multiple instances of VistA.

# How We Got Here, continued

- We came up with an approach for MedRec that allowed the VA to have multiple people collaborating (including the patient) during a reconciliation session, from geographically diverse locations and we were able to capture everything that happened – every change of state of what was being presented, whether it was an allergy or medication or clinical note.
- It did it at such a granular level that we were able to create this idea of a “black box flight recorder”. One of the issues became, how does a clinician know when he or she is done with a session and wants to submit it to analytics, that the data has not been tampered with or changed improperly.
- **Blockchain offered an obvious benefit to solve this problem and it had nothing to do with distributed anything!**

# Where We're Going

- Apex is developing a platform based on our experience in data federation and reconciliation to focus on the operational side of interoperability.
- We leverage blockchain in several specific places in the architecture where it makes sense, but it is by no means the sole component of the solution to the problem of data interoperability.
- Our approach addresses a core limitation with current databases – they suffer from an *information model* that does not grapple properly with time and truth, thereby limiting what you can express in the *data model*.
- The immutability of data on a blockchain allows you to think outside the box in terms of how we think about identity, state and change over time.

**This will have a radical impact on how we think about building distributed data-sharing systems!**

# Where We're Going, continued

- Consensus on a blockchain refers to the operational semantics of how information is accreted to the blockchain. Consensus models are also concerned with security, fault recovery and trust.
- However, when you look at what actual data is on the blockchain and what you can do with it, there is an interesting problem that emerges as soon as you have this desired state of interoperability – all these systems have *a different representation of truth about the identities that they have in common*.
- This results in a perspective problem, not just a consensus problem.

# Where We're Going, continued

- Our approach focuses not only on the data reconciliation challenge, but better ways to vet what is true over time and then to properly align all systems of record that know about that shared identity.
- We need the ability to take everything known about that identity and then reason about it.
  - *Traditional information models breakdown at precisely this requirement!*
- In our solutions, we therefore work heavily with linked data technologies which we are finding offer greater value in the problem area of detecting discrepancies as well as identifying and learning over time which sources of data are more reliable.

# Where We're Going, continued

- We applied these concepts as part of the 2021 VA National Artificial Intelligence Institute Tech Sprint Series, where the Apex Team was a Tech Sprint Finalist & the Administrative Cohort Winner.
- The work conducted by the Apex Team resulted in a 2022 FedHealth IT Innovation Award to U.S. Department of Veterans Affairs National Artificial Intelligence Institute for the Provider Directory Interoperability Use Case.
- The Apex Team was recently awarded a contract by the VA to continue this work as part of a broader Provider Directory Pilot Use Case in collaboration with the VA, HHS & CMS

# Questions?



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**Thank you for joining us today!**

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