

Blockchain in Healthcare - Layered View

Layer 4

Artificial Intelligence and **Machine Learning** Enable Major New Insights, Value

Layer 3

Cryptocurrencies and **Tokens** Enable New Commerce and Incentive Systems

Layer 2

Smart Contracts Increasingly Automate Transactions, Improving Efficiency

Layer 1






Blockchain Enables Secure Sharing of Healthcare Data Across B2B Networks

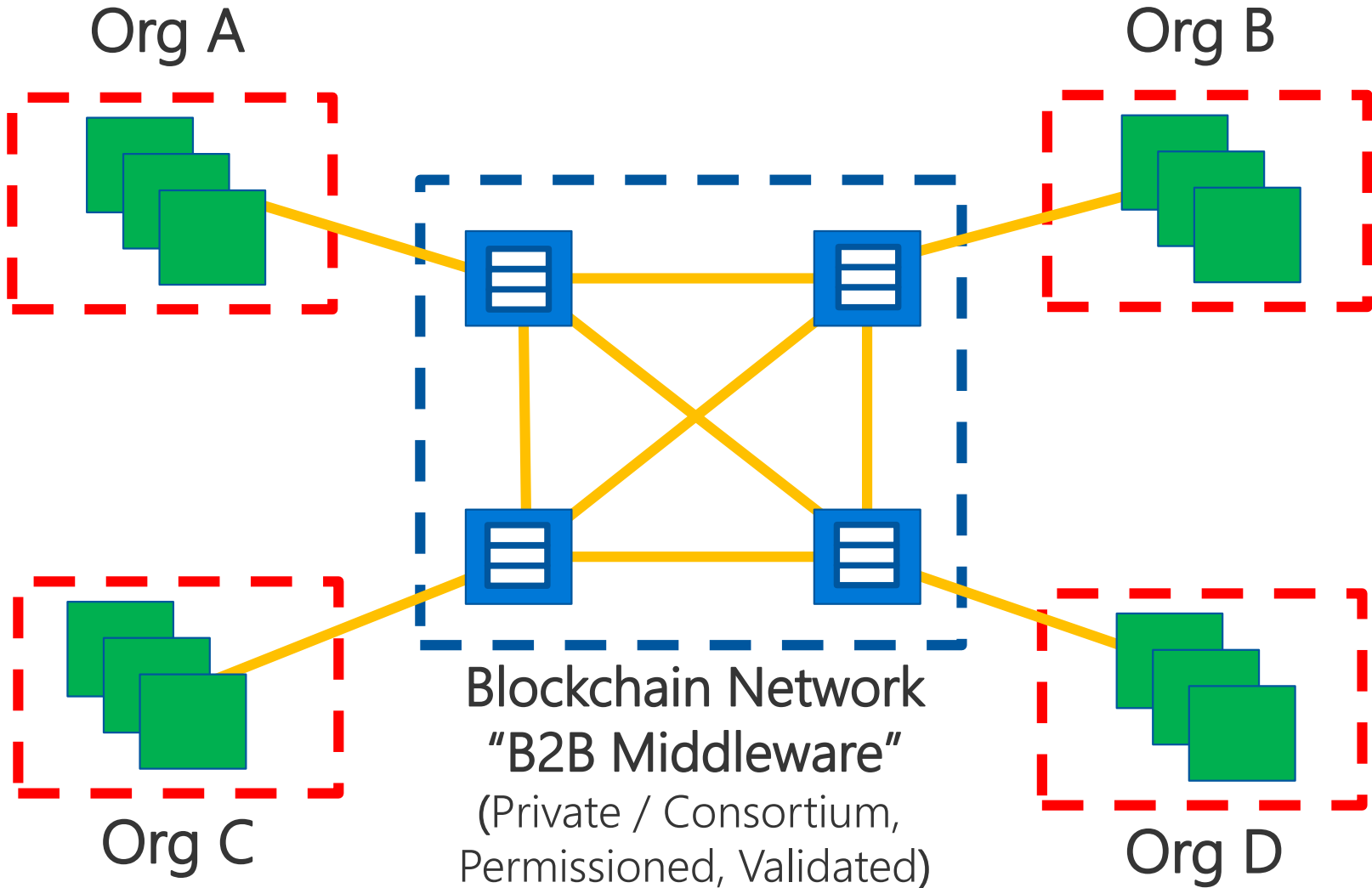
Layer 0

Healthcare Data Mostly in **Silos**, Little Sharing, Massive Untapped Potential

Blockchain Architecture

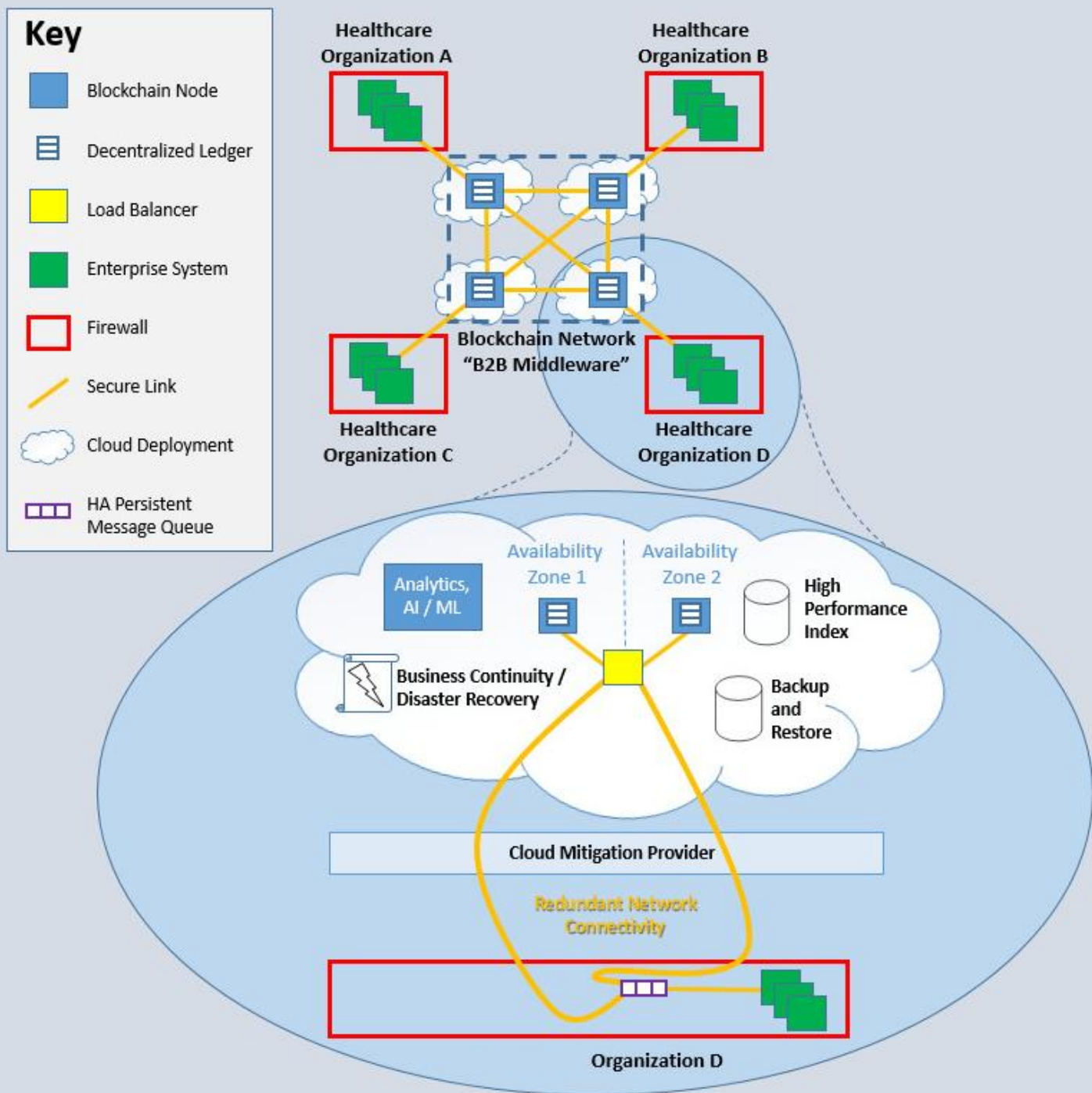
Key

-  Blockchain Node
-  Decentralized Ledger
-  Enterprise System
-  Enterprise Internal Firewall
-  Secure Link

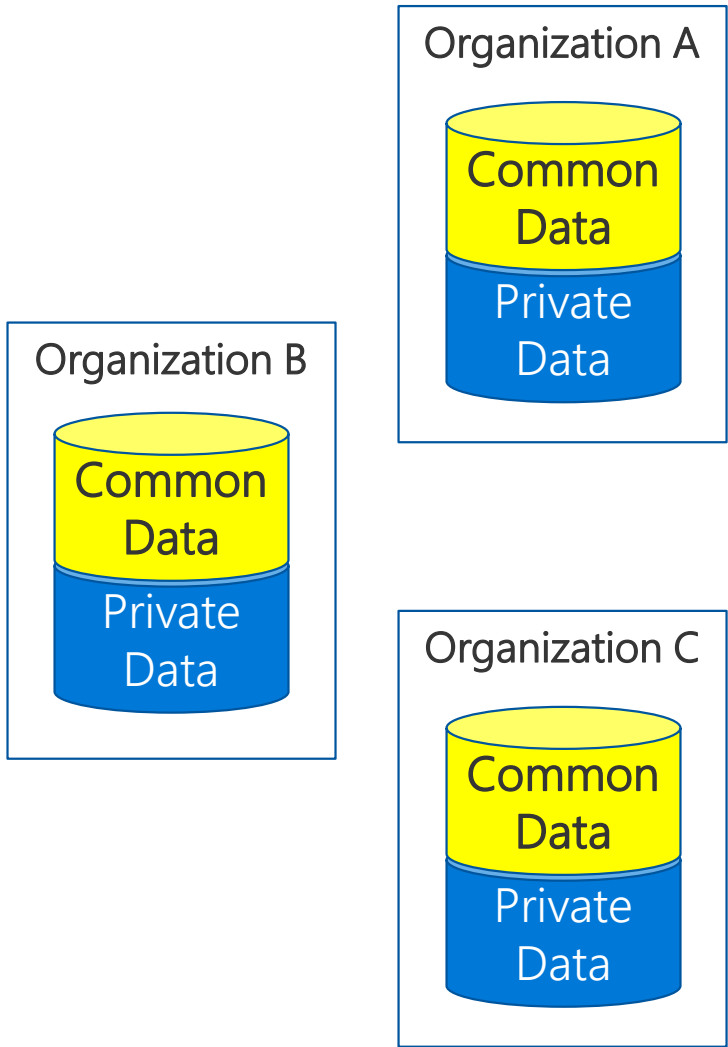


Blockchain Node Deployment

- On premises
- In cloud
- Heterogeneous deployment options
- Consistent consensus

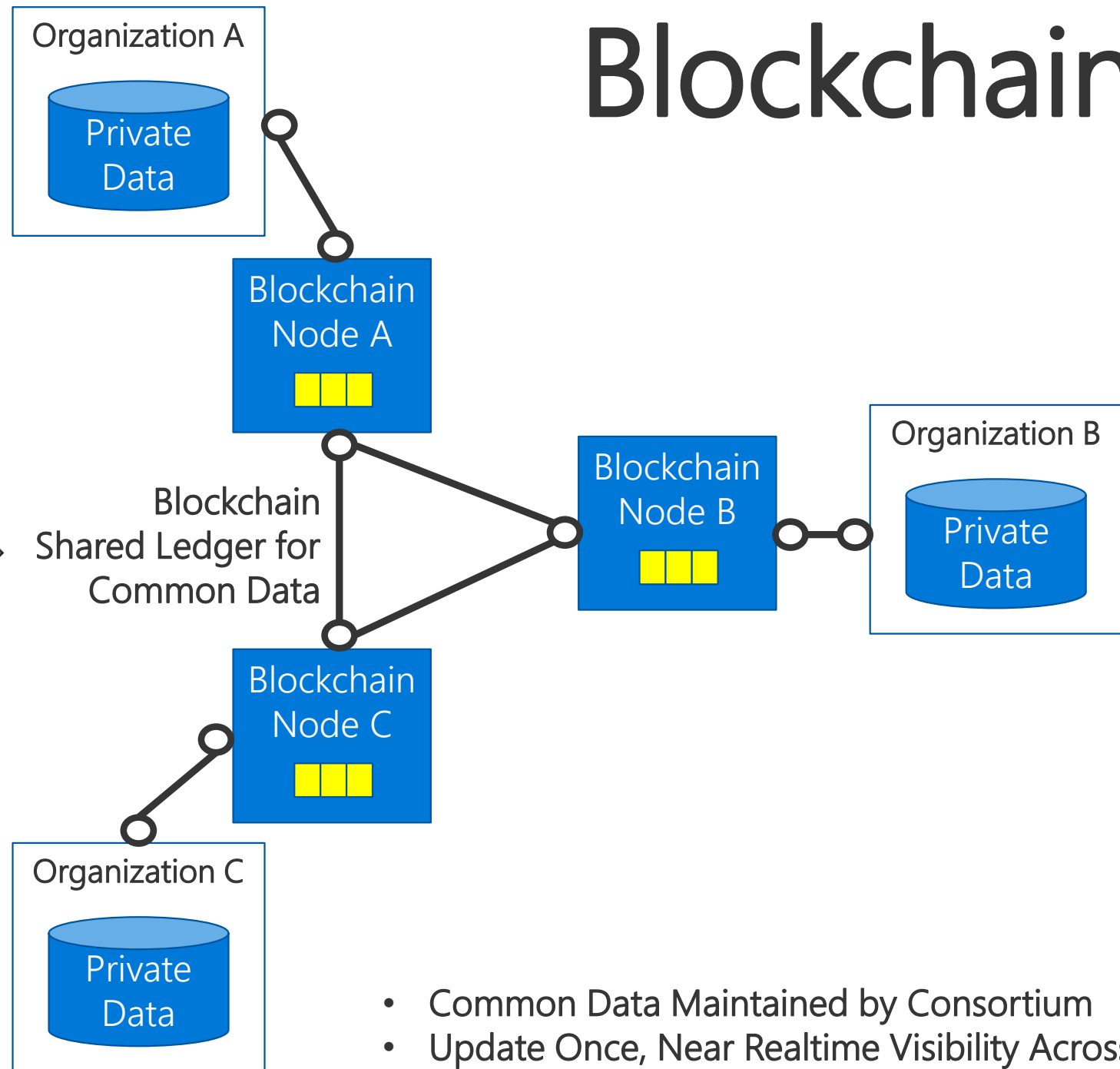


Today



- Redundant Maintenance of Common Data
- Inconsistencies, Causing Friction

Blockchain



- Common Data Maintained by Consortium
- Update Once, Near Realtime Visibility Across

Is Blockchain a Missing Cog in Health IT?



- Major healthcare benefits in **secure, targeted sharing** of patient data
- Today enterprise systems and data **siloed** within healthcare organizations
- Only **limited sharing** of healthcare data
- **Blockchain**
 - Enables secure targeted sharing of healthcare information
 - Co-exists and integrates with enterprise systems
 - Can provide the “**missing cog**” for secure exchange of data
- Enables **new levels of collaboration** to **reduce costs and improve outcomes, engagement, experiences**

Blockchain Strengths

- Secure, targeted sharing of data, where it makes business sense
- Data integrity
- Transparency
- Decentralization, resilience, availability of the network
- Anti-fraud



Identifying Use Cases and Business Value Propositions

- Its about the network of organizations, not a database
- Collaboration around shared data for business value
 - Reducing healthcare costs
 - Improving patient outcomes
 - Improving patient engagement, experience
 - Improving healthcare professional experience
- Existing healthcare B2B networks are near term opportunities

Delivering Value with Blockchain – Healthcare Examples

Use Case	Reduce Cost	Improve Patient Outcomes	Engage Patients, Enhance Experience	Enhance Healthcare Professional Experience
Provider Directory	✓			
Drug Supply Chain	✓	✓	✓	✓
Medical Device Track and Trace	✓	✓	✓	✓
Health Information Exchange	✓	✓	✓	
Provider Credentialing	✓			✓
Anti-Fraud	✓		✓	

Grapevine World | Clinical Trials



Challenge

- Lack of patient participation in clinical trials, and consequently inadequate data available for clinical research.
- Inadequate data provenance leads to irreproducible clinical trials.

Strategy

- Grapevine World blockchain enriched IHE solution enables patients to opt-in to clinical research, incentivizing them to do so with crypto-tokens. Provenance information for clinical data was managed using blockchain.

Results

- Hyperledger Fabric blockchain powered by Microsoft Azure enables tracking of provenance information for clinical data, reproducibility is ensured.
- Ethereum based crypto-tokens reward patients for participation in clinical trials.

Spiritus | Medical Device Track and Trace

Challenge

- Slow medical device recalls which can often take over a year to complete, increasing risk to patient safety, and increasing costs and delays.
- Lack of longitudinal record of history of maintenance of medical devices.

Strategy

- Spiritus blockchain enables tracking of medical devices from implants, to wearables, to machines such as MRI's from manufacturing through the supply chain and the complete lifecycle, and maintenance.

Results

- Blockchain powered by Microsoft Azure enables tracking of medical devices and their maintenance, enabling expedited recalls, improving patient safety and lowering costs, and improving the quality of medical devices.



Adents | Drug Supply Chain



Challenge

- OECD estimates 10% of pharmaceutical products sold worldwide and 2.5% of global imports are counterfeit, increasing costs, and adding risk to patient safety.

Strategy

- Adents NovaTrack, powered by Microsoft Azure, offers open, integrated blockchain-based end-to-end supply chain traceability.

Results

- Secures the supply chain, reduces counterfeit drugs, lowers costs, improves patient safety.

Building the Consortium, Buy-in, Trust

- B2B middleware
- Building the consortium, trust is the hard part
- Existing B2B networks are early opportunities and points of traction
- Add blockchain to deliver additional business values
- Prove blockchain out, pave way for revolutionary use cases



Security

- Protect CIA of sensitive data and systems
 - **Integrity**
 - **Availability**
 - Network
 - Nodes
 - **Confidentiality**
- **Adequacy** of security across the consortium



Privacy

- Privacy risks, and strengths
- Minimal but sufficient data
- Avoid PII / PHI on blockchain where possible
- Ability to review and amend data
- Consent, opt-in / opt-out
- Transparency through data lifecycle: collection, storage, use, disclosure, disposal
- Access: audit trails, user ability to review



Compliance

- Types of data on blockchain
 - PHI
 - PII
- Location of blockchain nodes
- Data sovereignty / trans-border data flow
- Immutability and right to be forgotten



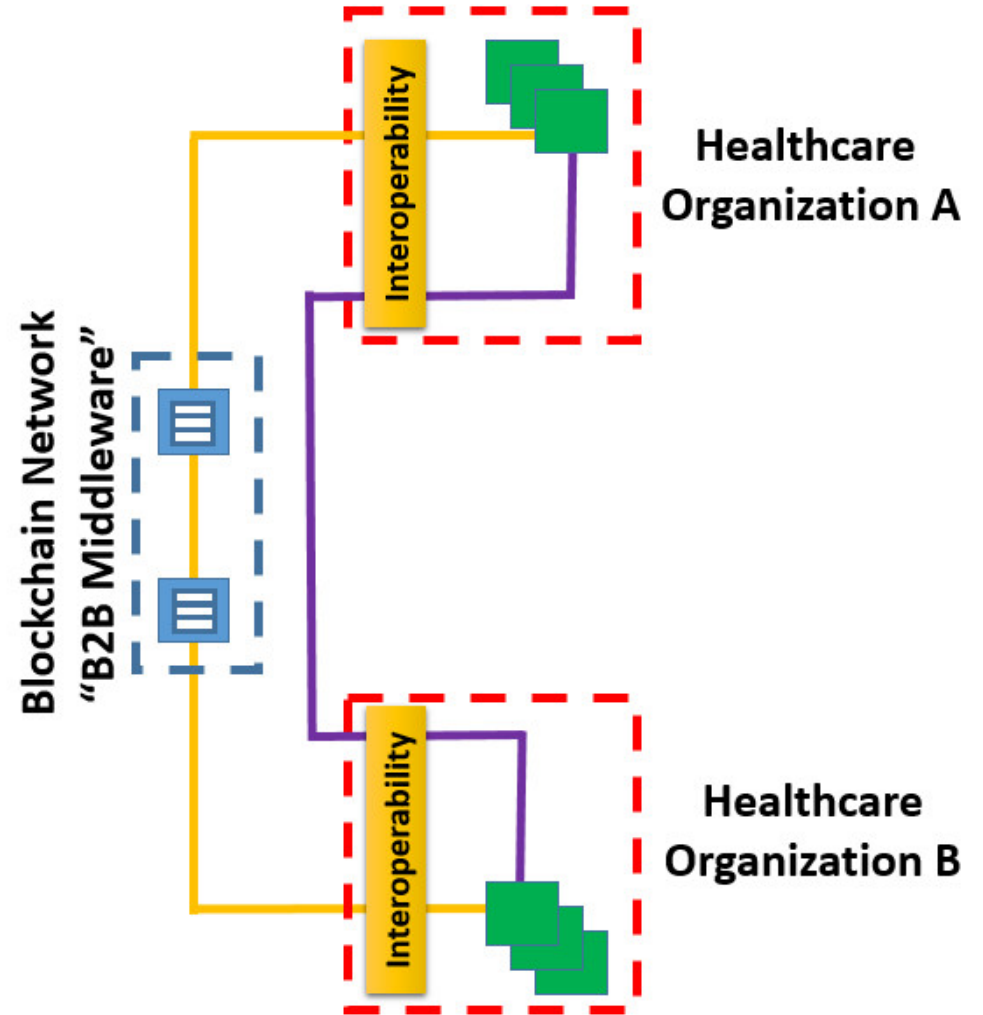
Performance, Throughput, Scalability

- Bitcoin: ~ 1 per 10 minutes
 - Public, untrusted, conservative consensus
- Vast majority of blockchain is private
 - No mining. Not storage or compute bound. Network bound
 - Consensus algorithm type paramount
 - Typical throughput from 100's to 1000's blocks per second
- Batching transactions in blocks for higher throughput
- Check your use case performance and throughput requirements early for blockchain suitability



Integration, Interoperability

- B2B middleware integrated with enterprise systems
- Interoperability critical for success
- Blockchain doesn't deliver interoperability
- Blockchain depends on interoperability
- Blockchain should maximize use of existing applicable interoperability standards, eg FHIR
- Blockchain is a forcing function and opportunity for us to get interoperability right!



Pilot, Case Study / Attestations, Scale

- Multiple blockchain pilots in progress, ending in 2019
- Consortiums of recognizable, respected organizations
- Centered on use cases and business value(s)
 - Provider Directory
 - Provider Credentialing
 - Etc
- Results and case studies with attestations of business values, and areas to improve are imminent
- Establish a solid foothold to scale consortiums, use cases

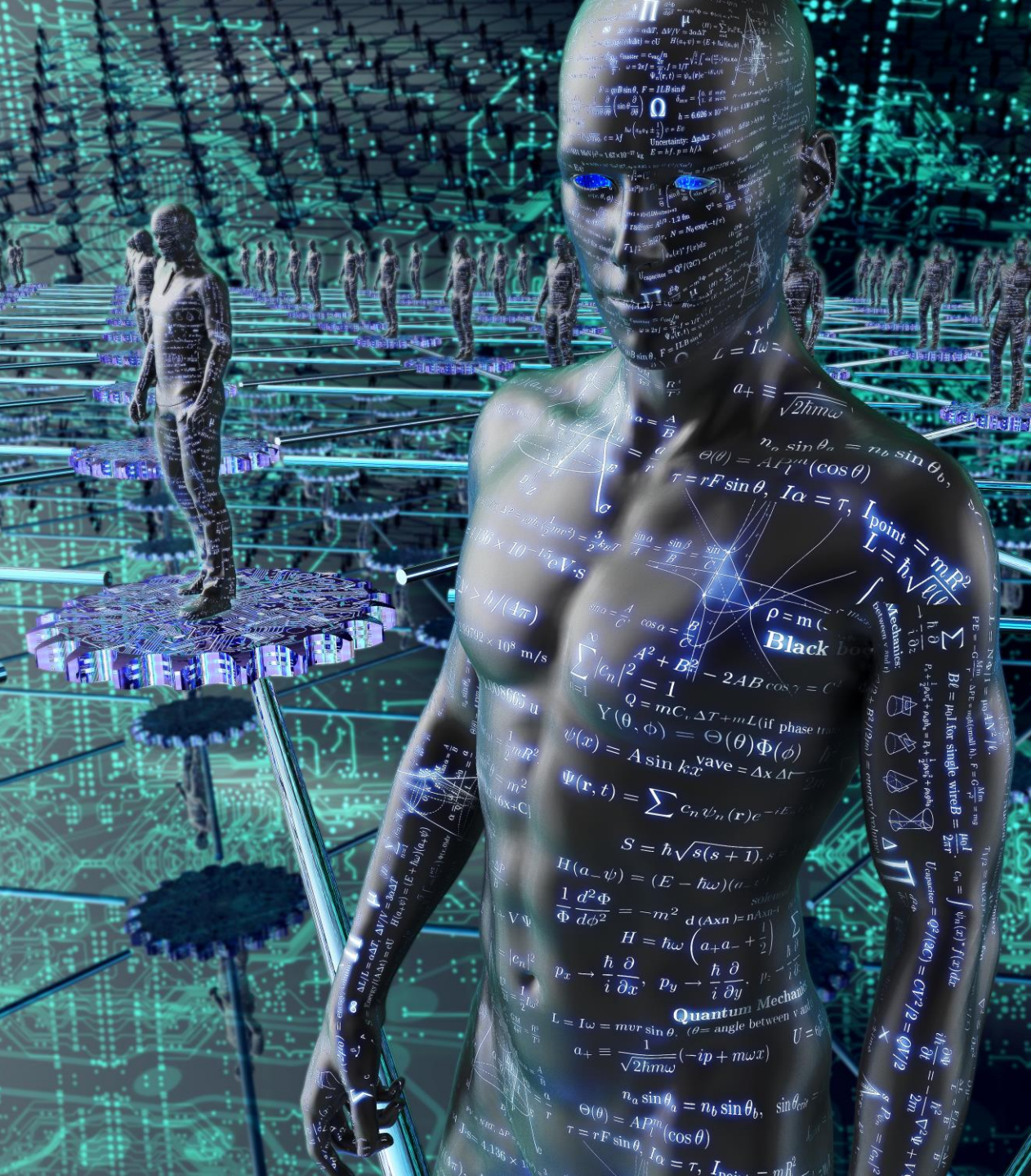


Blockchain Evolution: Opportunities and Barriers

- Mostly private / consortium blockchains
- An archipelago of blockchain islands
- Interoperability challenge
- Pilots, case studies, attestations
- Natural selection
- Winners scale in size, use cases, network effect
- Gradual move over time to larger islands
- Pave way for richer smart contracts, DAOs



Blockchain Ethical Considerations

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- Patients Own Data
 - Patients Monetize Data
 - Disintermediation, and Disruption
 - Hyper-Efficiency, Job Loss
 - Environmental Impacts
 - Anonymity, Cryptocurrency, and Crime

Source: [Blockchain: 6 Key Ethical Considerations](#)

Blockchain at Microsoft

- Platforms

Azure runs most blockchains. Ethereum, R3 Corda, Hyperledger Fabric are currently the most enterprise ready blockchain platforms. All three run on Azure today across 54 regions and 140 countries [worldwide](#). Azure has 91+ [certifications and attestations](#) including HIPAA, HITRUST, GDPR, and many more.

- Tools

Azure Blockchain Workbench: rapid development and deployment of blockchain apps on Azure. Currently supports Ethereum. Future: R3 Corda and Hyperledger Fabric.

- Partnership

Microsoft partners with startups, ISV's, SI's, and other solution providers serving healthcare to empower them to do more to reduce healthcare costs, improve patient outcomes, engagement, and experiences.



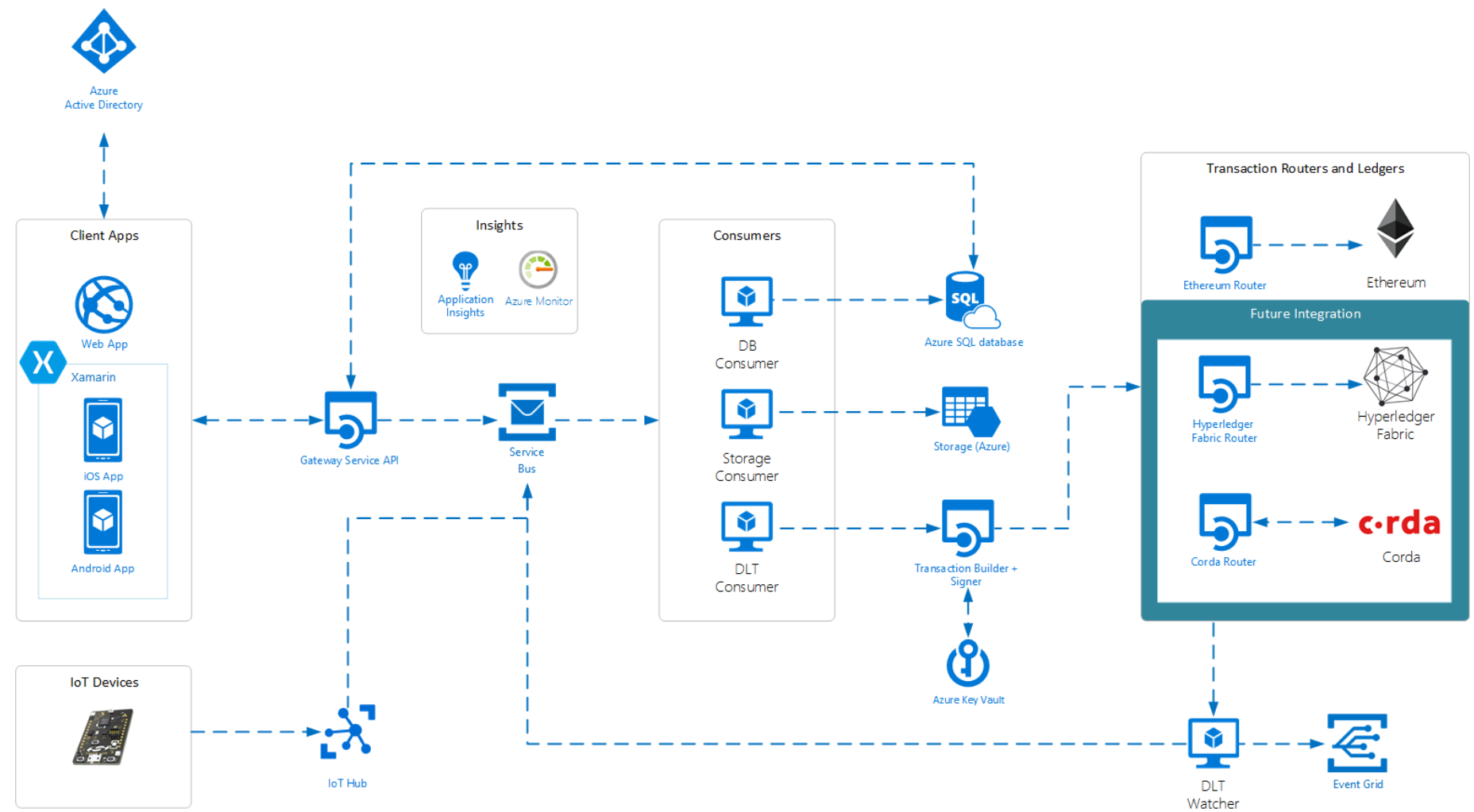
Key Resources and Recommended Next Steps

1. [Microsoft Azure Blockchain](#)

- Develop, test, and deploy secure blockchain apps on Hyperledger Fabric, R3 Corda, or Ethereum

2. [Azure Blockchain Workbench](#)

- Rapid development and deployment of new blockchain applications



3. EBC Topic: [Blockchain as a Service in Azure](#)

Contact

David Houlding MSc CISSP CIPP
Principal Healthcare Lead | Microsoft



David.Houlding@Microsoft.com



[LinkedIn.com/in/DavidHoulding](https://www.linkedin.com/in/DavidHoulding)



[@DavidHoulding](https://twitter.com/DavidHoulding)



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Thank You