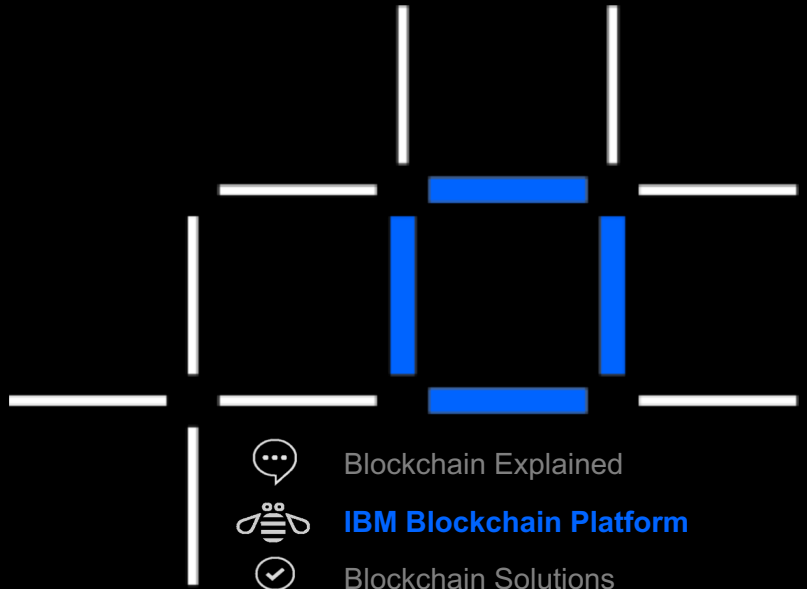
IBM Blockchain Platform Explained

An Introduction to IBM Blockchain Platform



V1.08, 3 April 2018

IBM **Blockchain**

IBM

IBM Blockchain Platform Overview

What you need to know

Getting Started

The tools to make your blockchain real

Roadmap

IBM's blockchain strategy and where the platform is going

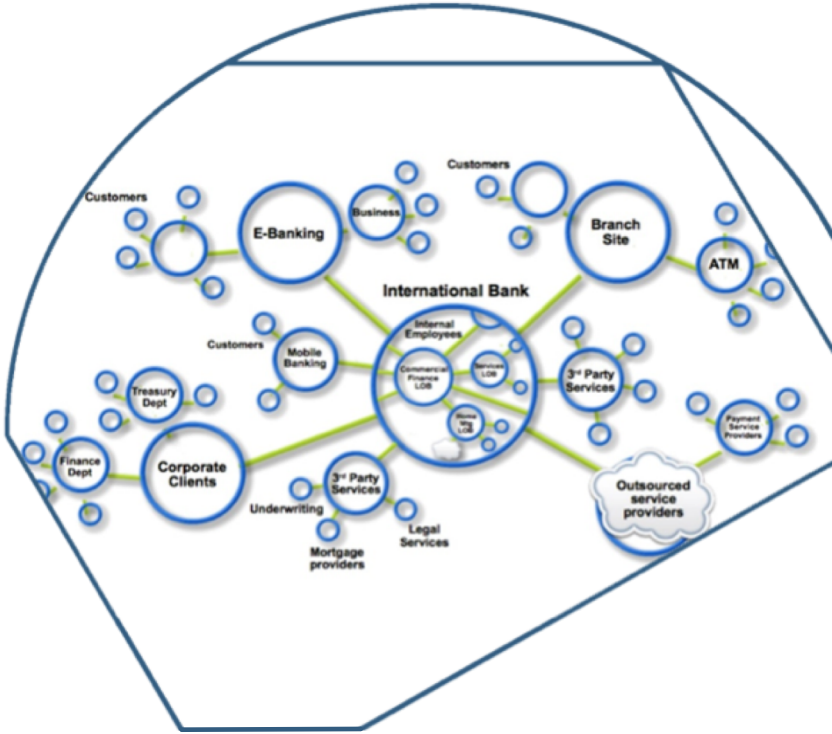
Technical Details

The architecture behind IBM Blockchain Platform

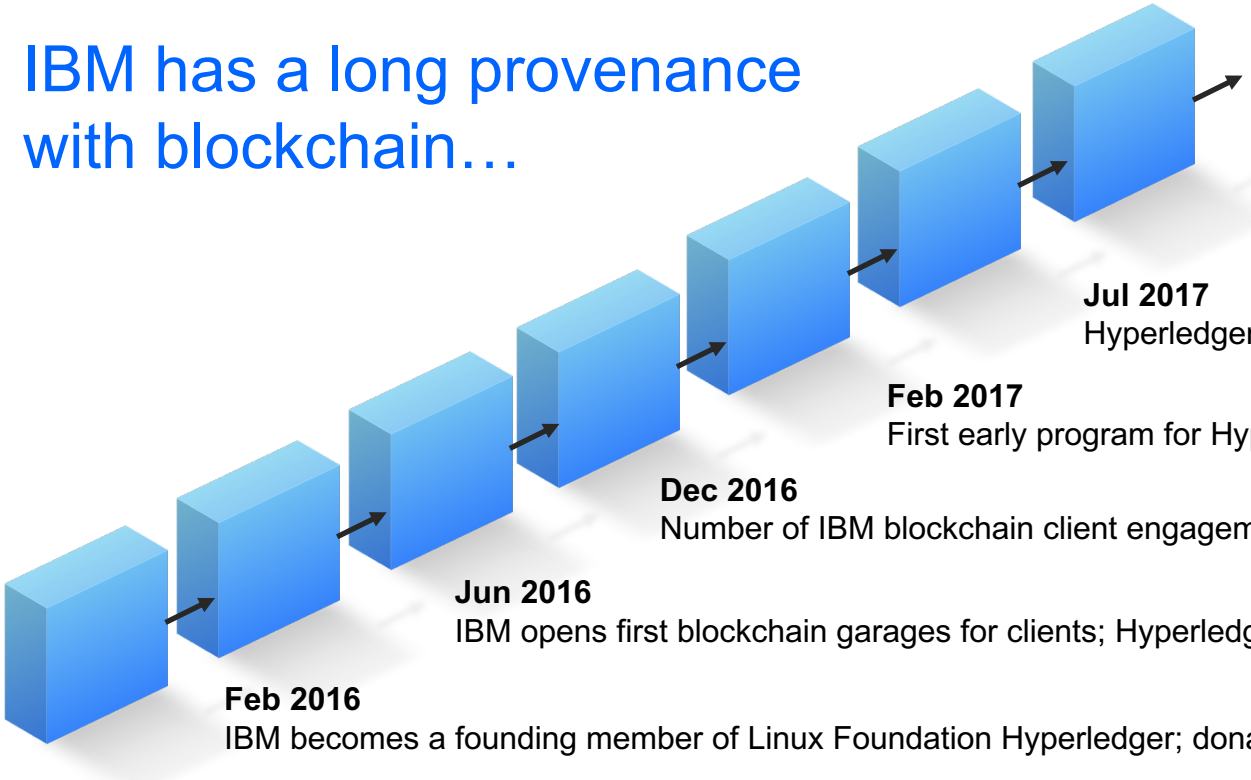
Blockchain Recap

- **Blockchain** is a shared, replicated ledger
  - Permissioned blockchains bring trust to business networks through consensus, provenance, immutability and finality

- **Linux Foundation Hyperledger** is a collaborative effort created to advance cross-industry blockchain technologies for business
  - Hyperledger **Fabric** is a blockchain providing implementation of a ledger, smart contracts, privacy and consensus
  - Hyperledger **Composer** is a suite of tools that make it easy to develop blockchain applications



IBM has a long provenance with blockchain…



Aug 2017
IBM Blockchain Platform announced

Jul 2017
Hyperledger Fabric v1.0 released

Feb 2017
First early program for Hyperledger Composer run in IBM labs

Dec 2016
Number of IBM blockchain client engagements now totals over 400

Jun 2016
IBM opens first blockchain garages for clients; Hyperledger Fabric v0.6 released

Feb 2016
IBM becomes a founding member of Linux Foundation Hyperledger; donates code and intellectual property

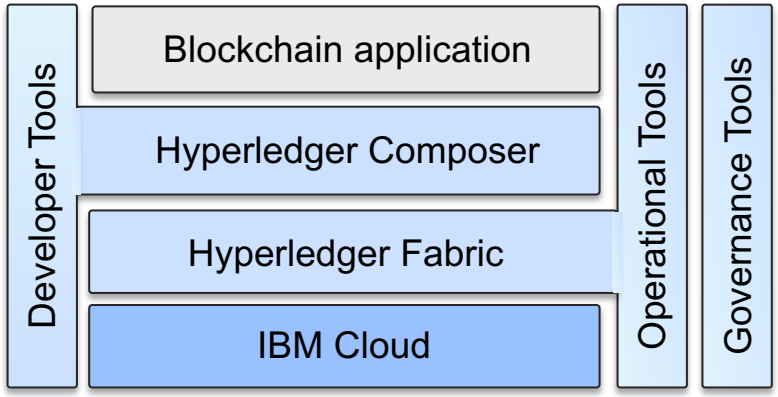
Aug 2015
IBM starts developing first prototype of blockchain technology (Open Blockchain); first client engagements

Introducing the IBM Blockchain Platform

http://ibm.biz/Platform_Demo

IBM Blockchain Platform is a fully integrated enterprise-ready blockchain platform designed to accelerate the development, governance, and operation of a multi-institution business network

- **Developer tools** that make use of Hyperledger Composer to quickly build your blockchain application
- Hyperledger Fabric provides the ledger, which is managed through a set of intuitive **operational tools**
- **Governance tools** for democratic management of the business network
- Flexible deployment options, including a highly secure and performant **IBM Cloud** environment



End-to-end lifecycle coverage

Develop

- Accelerated creation of blockchain applications
- No-charge development and test tools hosted on IBM Cloud
- Based on popular Hyperledger Composer toolset

Govern

- Activate, customize and change complete blockchain business networks
- Secure democratic governance across organizations
- Implement rules for authorizing network updates

Operate

- Connect, deploy and manage blockchain peers with flexible deployment options
- Production ready, secure and scalable
- Based on Linux Foundation Hyperledger Fabric V1

Why IBM Blockchain Platform

Reduces risk

- Flexible pricing and support options for all sizes of deployments
- Democratic governance policies to help prevent unauthorized network changes

Saves time

- Implement blockchain projects more quickly
- Extensive toolset for development, governance and operation of blockchain networks

Enterprise ready

- Architected for High Availability and Disaster Recovery
- Highly secured and suitable for transactional workloads

Open

- Based on popular and open Linux Foundation Hyperledger technologies
- Avoid vendor lock-in! Embraces open source, open standards and open governance

Platform Value: *Simplicity in the face of overwhelming complexity*

	IBM Blockchain Platform	Community Code Deployment
Inviting members	5 seconds	20 minutes per instance
Installing and instantiating smart contracts	Single click installation	10 minutes per smart contract per peer
Deployment	Specify network parameters and automatically launch ordering service	Not available
Network alterations and additions	Add new members, channels and smart contracts through single clicks, text box or drop down via the UI	CLI driven, and more advanced skills required
Support	Complete support from the HW stack through the blockchain code base included	Not available
Security	Secure container and highest level of security provided	Custom
Migration	Rolling migration and 99.999% availability provided under the covers	Not available

"IBM provides us with the easiest way to develop prototype blockchain applications for our clients. Thank you!"
-- Global consulting firm

"IBM has enabled our team to develop our blockchain demo with minimal hassle and gives us a clear path to scale with the tools to manage it"
-- Series backed start-up

Flexible pricing plans

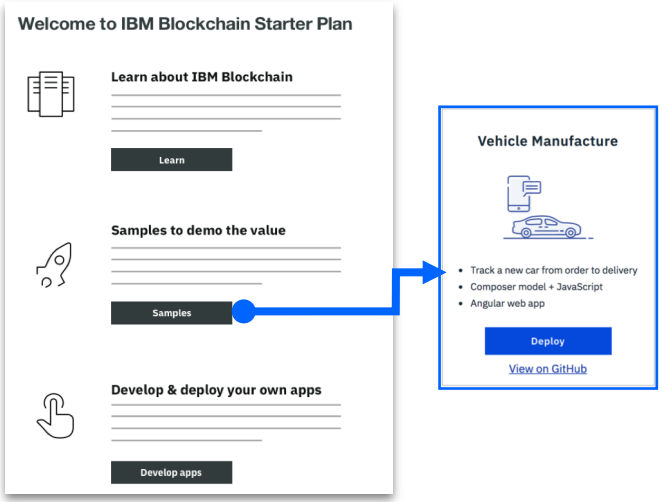
Plan	Key Features	Deployment
Starter	Easy on-ramp for blockchain-as-a-service	IBM Cloud
Enterprise	Production plan for industries comfortable with cloud	IBM Cloud
Enterprise +	Production plan for regulated industries, multi-region HA/DR and highest performance	IBM Cloud
Support-only	Supported instances of Hyperledger Fabric and Composer running outside IBM Cloud Platform	Docker

Starter Plan

Sign up at
www.ibm.com/blockchain

- Get started with IBM Blockchain Platform with **one-click setup and a fully functional network**
  - Configured for two organizations with one peer each, sample applications and informational tutorials
  - Environment enables iterative development prior to production deployment
  - Same experience as Enterprise
    - Uses SOLO ordering for simplified configuration, development and testing

- Currently in beta, and free until generally available
  - After that time, sign up for 30 day free trial
  - Expected charge: **$500 per month**
    - Assumes a two organization network
    - Total membership fee $250, plus per-peer cost of $125



Enterprise Plan

- Enterprise Plan is intended for **production or near-production** scenarios
  - Everything in Starter, plus everything you need for a full production environment
  - HSM availability, fault tolerant ordering service, added layers of securing and premium support
  - Single-zone HA/DR

- Monthly cost starts at **US$3000 per organization per network**
  - Assumes two peers for high availability ($1000 per peer plus $1000 membership fee)
  - Includes basic blockchain support only; support for services on IBM Cloud is an additional 10%
  - Certificate authorities and access to the ordering service is not chargeable

Enterprise+ Plan

- Enterprise+ Plan is also intended for **production or near-production** scenarios
  - Everything in Enterprise, plus multi-zone HA/DR and complete data isolation
  - Virtual circuits: VPN access from your data center

- Currently limited availability
  - Contact IBM for pricing information

IBM Blockchain Platform Membership Plans	Starter	Enterprise	Enterprise Plus
Suitability			
MVP			
Pilot & PoC			
Pre-production & Staging			
Production			
Features			
Deploy and run Composer apps			
Hyperledger Fabric features and capabilities			
Multiple org simulation			
Rolling migrations with no network outages			
Low-code interface			
Ability to scale			
Support options			
Fault tolerant ordering service			
Cryptographic Acceleration			
HSM Available		Coming soon	Coming soon
Advanced Secure container technology			
Isolated Compute Environment			
Multi-Geo/Site DR			

Support-only Plans

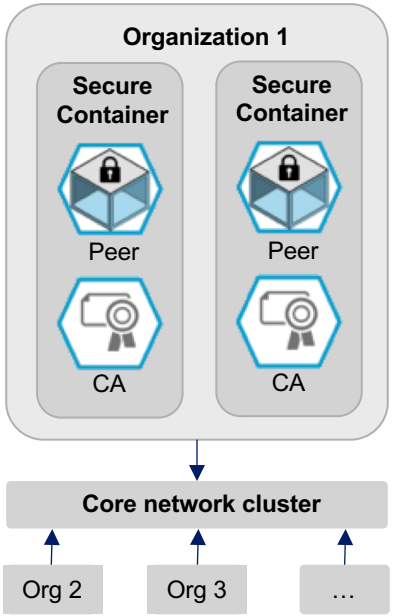
- Looking for **IBM support on Hyperledger Fabric or Composer**?
  - IBM produces signed Hyperledger Fabric images which can be supported for production usage outside of IBM Cloud
  - Hyperledger Composer supported within same plan
  - Available for LinuxONE (IBM Z), Power and x86 architectures
  - Subscription term one year

- **Elite tier** (5737-E89/DV13ALL)
  - Supported 24x7x365; response target within 2 business hours
  - Multiple technical contacts and developer assistance
  - Yearly cost $24,000 per peer

- **Entry tier** (5737-E90/DV13BLL)
  - Support hours Monday – Friday 8am-5pm local time; response target within 8 business hours
  - Single technical contact
  - Yearly cost $6,000 per peer

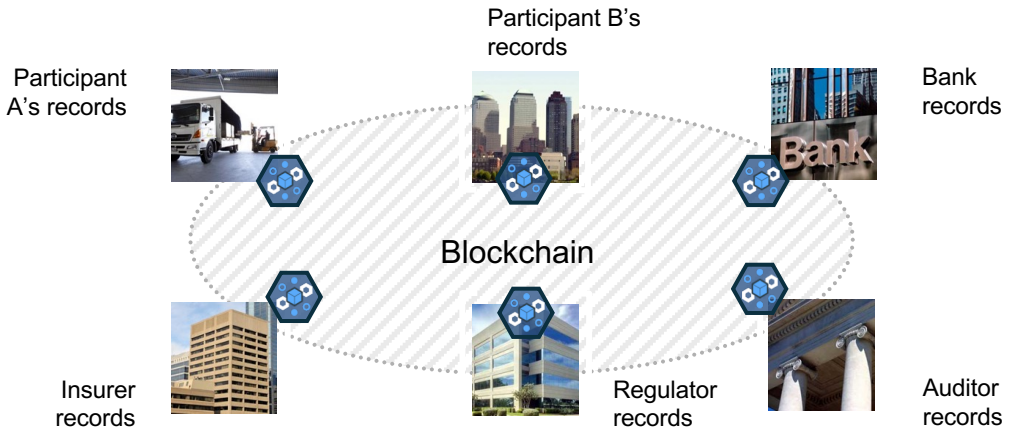
Platform Configuration

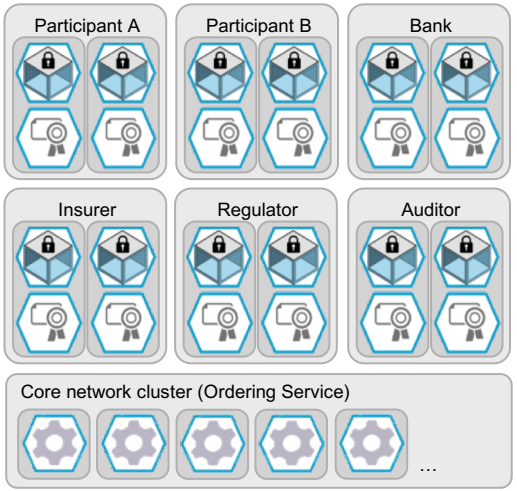
- Development environment
  - Try online, install locally or use Starter Edition
- Isolated peer clusters: one per organization
  - **Two active peers and two certificate authorities** per organization recommended (for high availability)
  - Each member provisions resources inside their IBM Cloud environment
- Core network cluster (for consensus)
  - Sits at the network level and is administered democratically by members in an administration group
  - Changes to the network occur democratically according to defined governance policies
  - Uses Kafka-based ordering service, providing crash fault tolerance



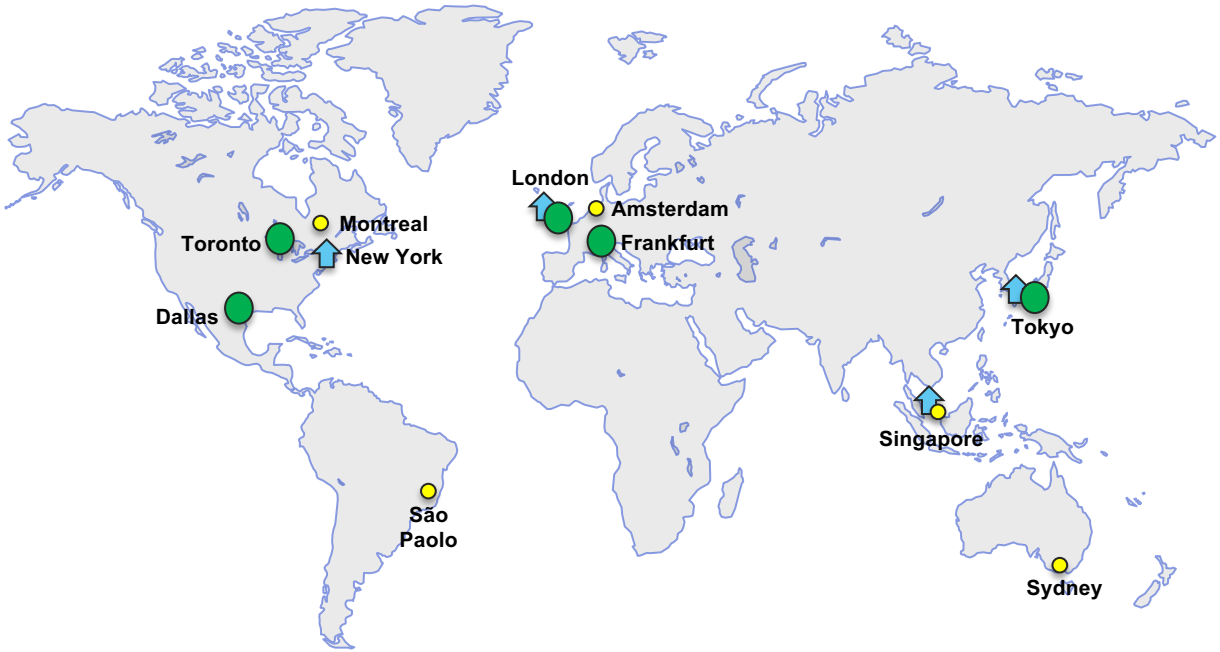
Example Network

- Consider an in-production blockchain business network comprising multiple organizations running Enterprise Plan on IBM Cloud
  - Each organization has two peers and two certificate authorities
  - Blockchain cost per organization (two peers + membership fee) = US$3000 per month
  - Support for IBM Cloud services @10% = US$300
  - Cost for one year per organization = 12 x US$3300 = US$39600





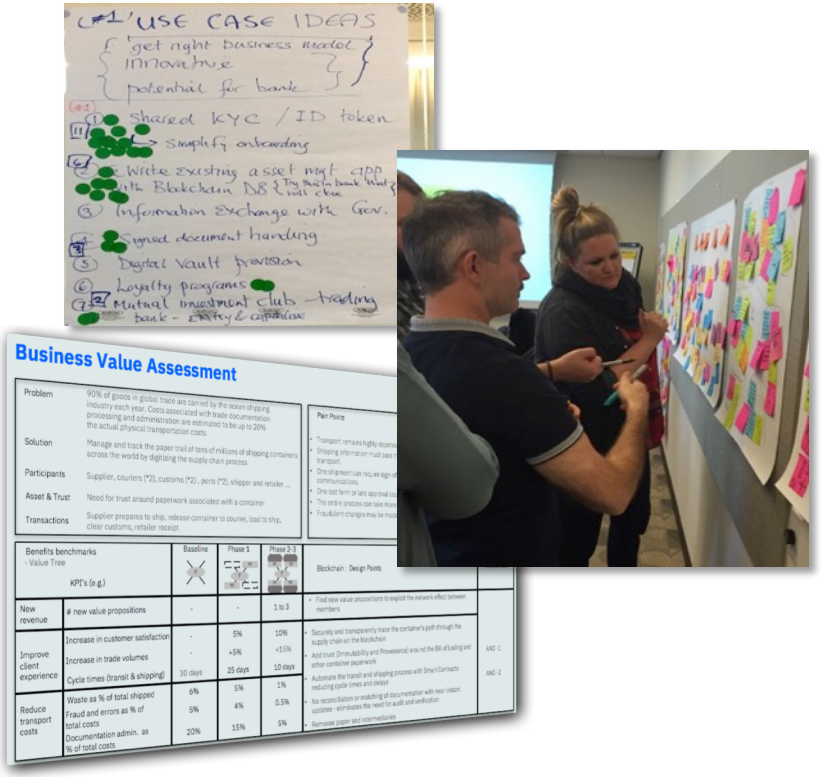
IBM Blockchain Platform Sites



- IBM Blockchain Platform Enterprise plan is hosted in multiple sites to help you satisfy data residency requirements
- More platform locations planned
- Complemented by a set of IBM Blockchain Garages to help you get started with IBM Blockchain Platform

  Learn more at www.ibm.com/blockchain

IBM can help you make your blockchain a success



- Every business network is different!
- IBM can help you with all stages of your blockchain network, for example:
  - Hands-on workshops
  - Blockchain Value Design
  - First Projects
  - Architectural Review
  - Services and Support
- Make use of the expertise located in the Blockchain Garages and in other locations worldwide

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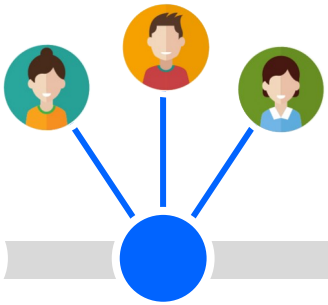


Your idea

The Business Network

?

IBM Blockchain Platform: Deve ×

blockchaindevelop.mybluemix.net/editor

Web energy-network | Define | Test | admin

FILES

About
README.md

Model File
models/energy-model.cto

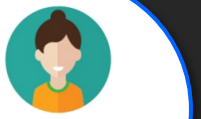
Script File
lib/business-logic.js

Access Control
permissions.acl

+ Add a file...

Script File lib/business-logic.js

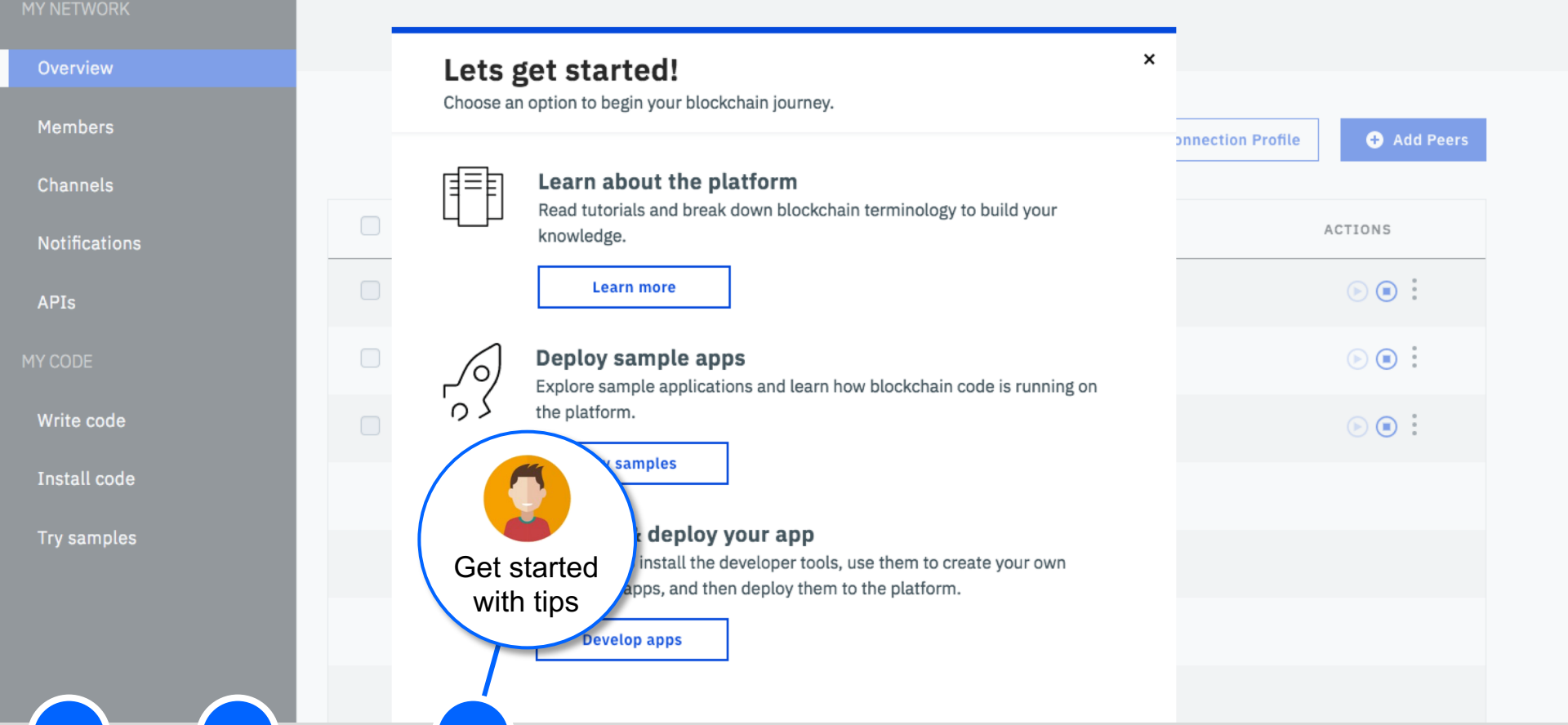
```
16   * Records the energy usage reading for a given household
17   * @param {com.energy.RecordEnergyReadingTX} tx the energy transaction instance
18   * @transaction
19   */
20  function recordEnergyReading(tx) {
21
22      // Get the asset registry for the energy readings.
        return getAssetRegistry('com.energy.EnergyReading')
            .then(function (assetRegistry) {
                // Put the energy reading in the asset registry
                return assetRegistry.add(tx.energyReading);
            })
            .then(function () {
                // Emit an event when the ledger is updated
                var event = getFactory().newEvent('com.energy', 'NewReadingEvent');
                event.energyReading = tx.energyReading;
                emit(event);
            });
34  }
```



Your idea

The Business Network

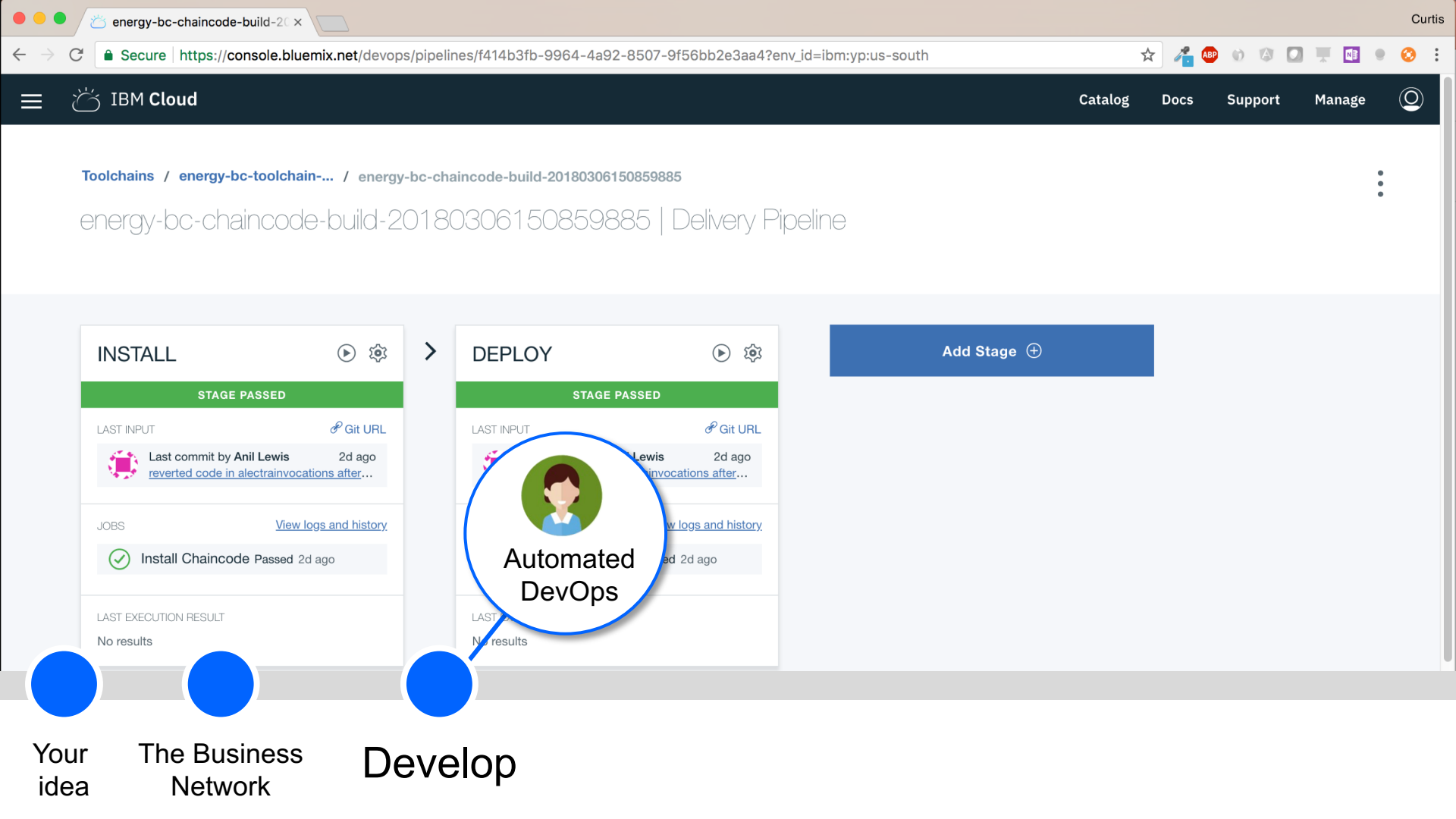
Develop

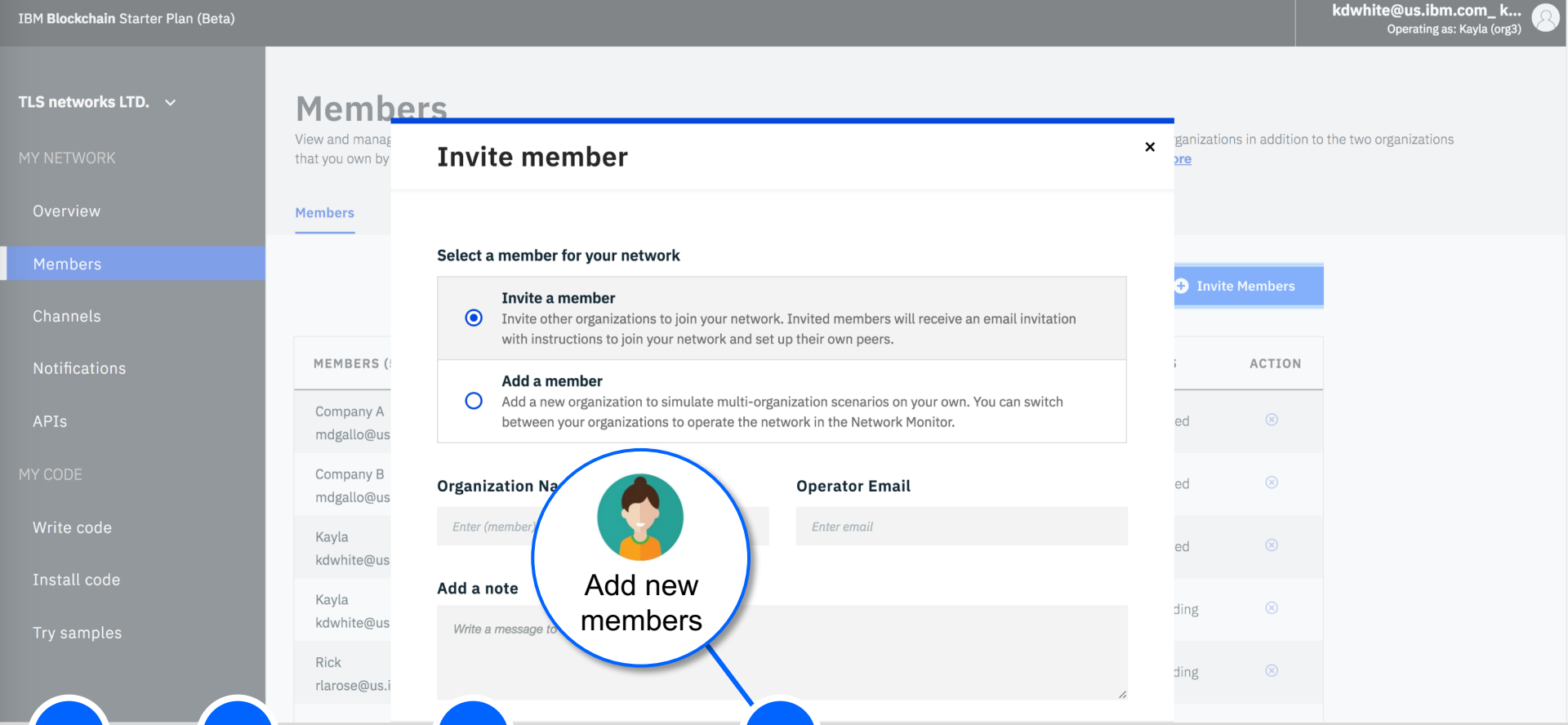


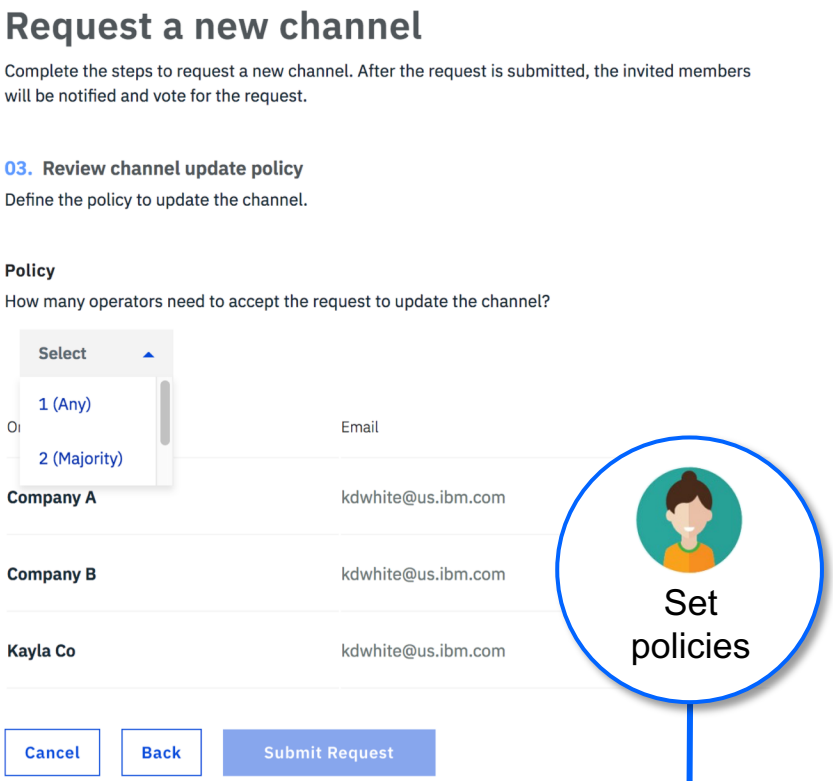
Your idea

The Business Network

Develop


energy-bc-chaincode-build-2(
Curtis
Secure https://console.bluemix.net/devops/pipelines/f414b3fb-9964-4a92-8507-9f56bb2e3aa4?env_id=ibm:yp:us-south
IBM Cloud
Catalog
Docs
Support
Manage
Toolchains / energy-bc-toolchain-... / energy-bc-chaincode-build-20180306150859885
energy-bc-chaincode-build-20180306150859885 | Delivery Pipeline
INSTALL
STAGE PASSED
LAST INPUT
Git URL
Last commit by Anil Lewis 2d ago
reverted code in alectrainvocations after...
JOBS
View logs and history
Install Chaincode Passed 2d ago
LAST EXECUTION RESULT
No results
DEPLOY
STAGE PASSED
LAST INPUT
Git URL
Automated DevOps
Add Stage
Your idea
The Business Network
Develop


IBM Blockchain Starter Plan (Beta)
kdwhite@us.ibm.com_ k...
Operating as: Kayla (org3)
TLS networks LTD.
MY NETWORK
Overview
Members
Channels
Notifications
APIs
MY CODE
Write code
Install code
Try samples
Members
View and manag
that you own by
ganizations in addition to the two organizations
ore
Members
Invite Members
MEMBERS (
ACTION
Company A
mdgallo@us
Company B
mdgallo@us
Kayla
kdwhite@us
Kayla
kdwhite@us
Rick
rlarose@us.i
Invite member
Select a member for your network
Invite a member
Invite other organizations to join your network. Invited members will receive an email invitation with instructions to join your network and set up their own peers.
Add a member
Add a new organization to simulate multi-organization scenarios on your own. You can switch between your organizations to operate the network in the Network Monitor.
Organization Na
Enter (member)
Operator Email
Enter email
Add a note
Write a message to
Add new members
Your idea
The Business Network
Develop
Govern



Set policies

Your idea

The Business Network

Develop

Govern

Network created!

Your Starter Plan network has two organizations, each with its own peer.

With this network you can test chaincode, deploy samples, and invite other members to collaborate.

Launch

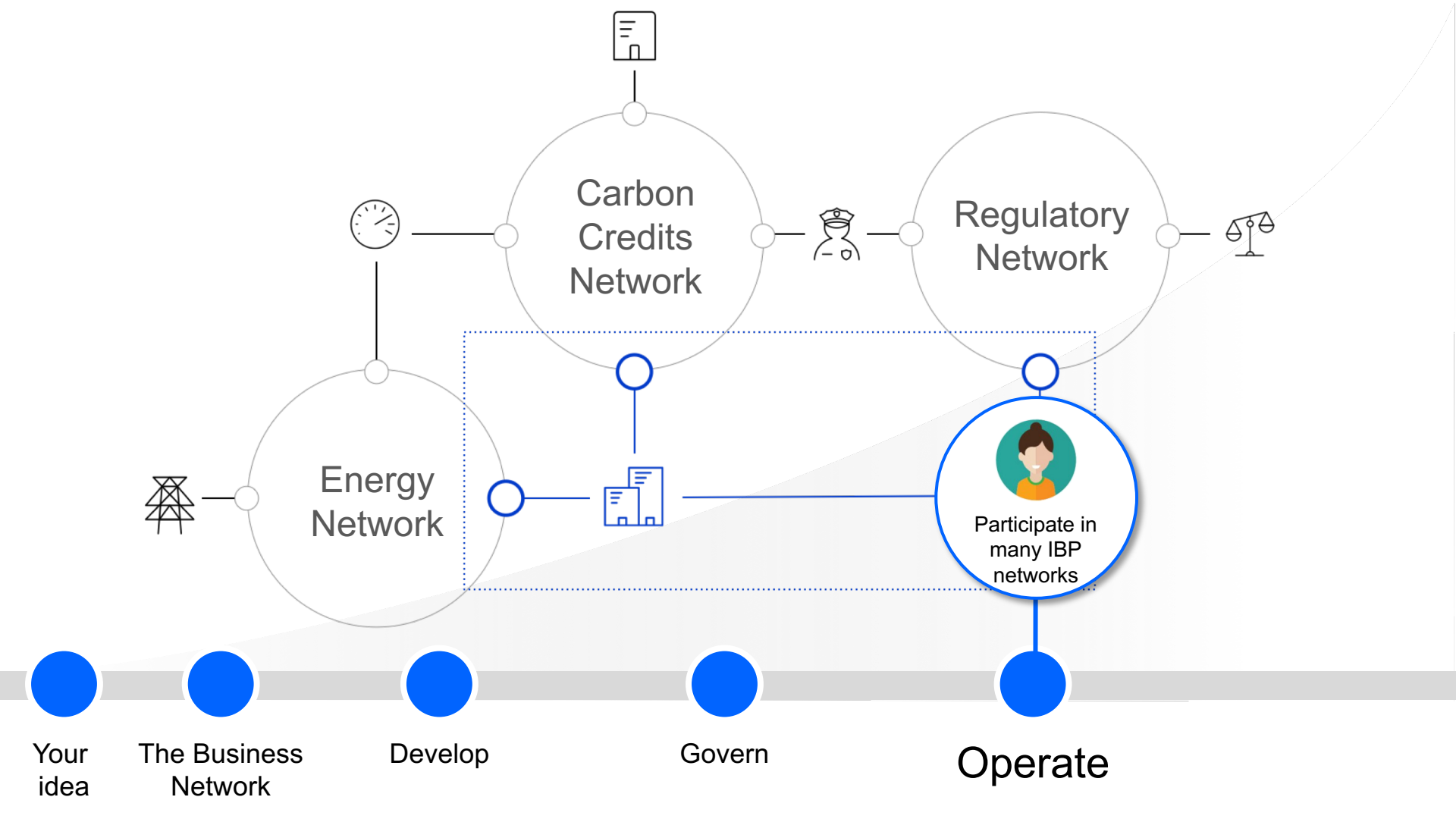
Your idea

The Business Network

Develop

Govern

Operate


Carbon Credits Network
Regulatory Network
Energy Network
Participate in many IBP networks
Your idea
The Business Network
Develop
Govern
Operate

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The tools to make your blockchain real

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IBM's blockchain strategy and where the platform is going

Technical Details

The architecture behind IBM Blockchain Platform

IBM Blockchain Strategy

Drive the development of **applications** for specific business use-cases, to be deployed to active **blockchain networks**

Services

Collaborate with services teams from ideation all the way to production

Ecosystem

Tap into our diverse ecosystem to develop strategic partnerships and create your competitive advantage

Solutions

Solve critical industry challenges by building and joining new business networks and applications

Platform

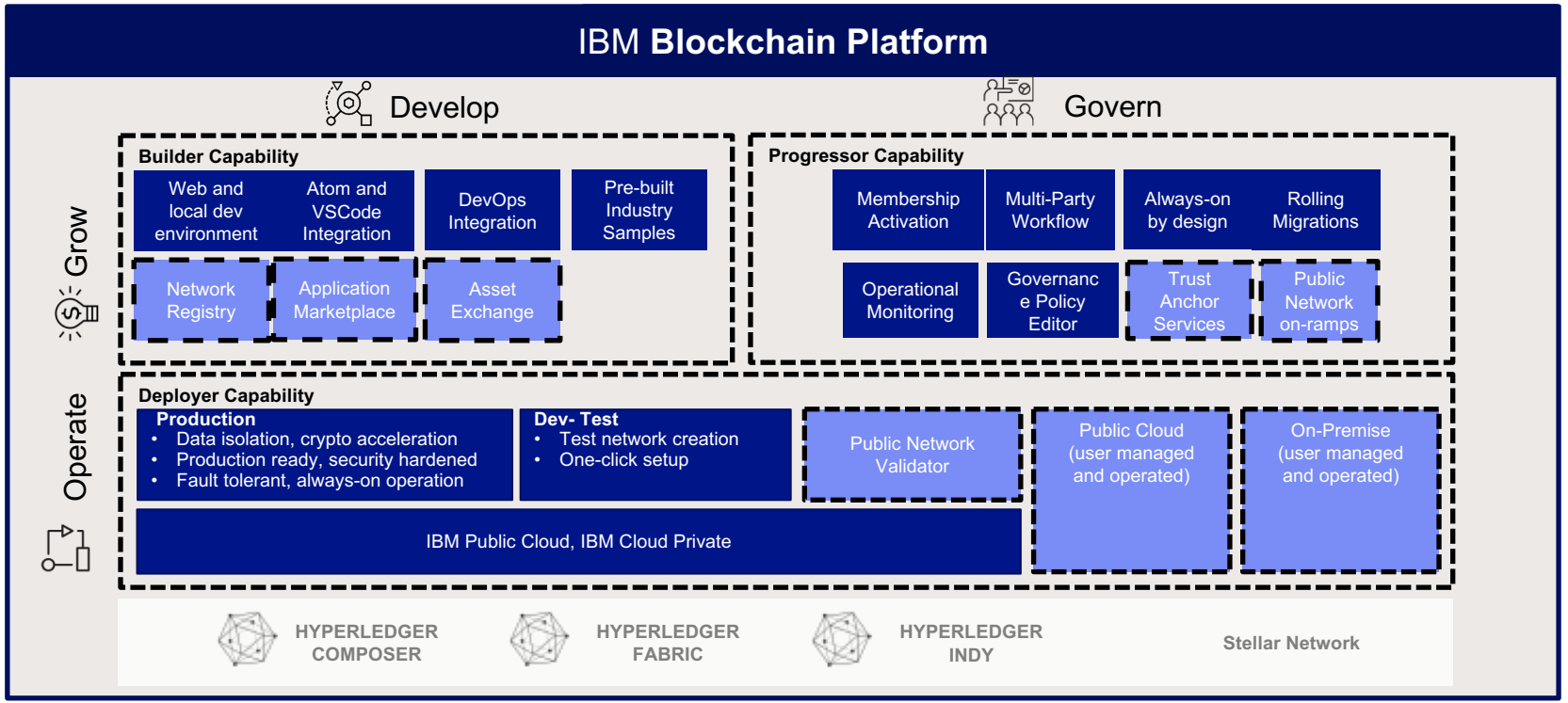
Develop, govern and operate enterprise blockchain networks with speed and security

HYPERLEDGER

A founding, premier member of Hyperledger, IBM is committed to open source, standards & governance

IBM Blockchain Platform

Solutions	Food Trust, universal payments, Global Trade Digitization, Identity, etc…
IBM Extensions	Watson IOT, API Management, Messaging, Workflow etc...



Included in IBM Blockchain Platform Coming Soon

Hyperledger Fabric and Composer Roadmap (Linux Foundation)

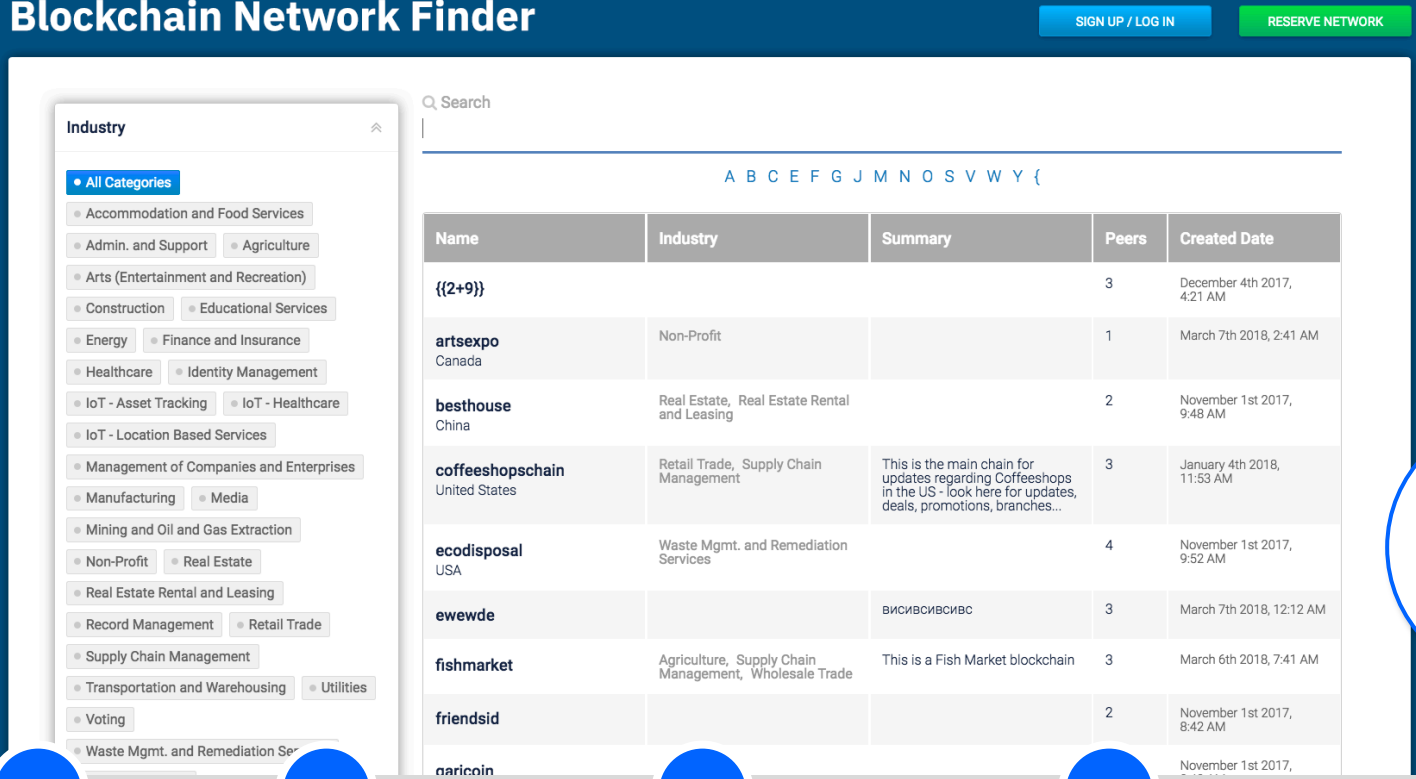
	Q1	Q2	Q3	Q4
Fabric	**1.1 release** • JS Chaincode • Channel events • CouchDB indexes • CRL • Mutual TLS • Connection profiles • Performance and scale improvements • Experimental: SideDB, fine-grained, access control etc.	**1.2 release** • UX improvements • Technical debt • Experimental from 1.1 • Native asset model • Pluggable transaction mode • State-based ownership • Flexible policies for chain code governance • Private transactions with SideDB • Service Discovery • Identity Mixer	**1.3 release** • Zero Knowledge Proof (confidential transactions) • RAFT consensus • Experimental: BFP consensus	**1.4 release** • TBD
Composer	**0.18 release** • Hyperledger Fabric JS Chaincode integration • Cloud storage for network identities • HSM support • Enhanced data collection • Application generator capability	**1.0 release** • Standalone test tool • Additional industry samples • Integrated documentation	**1.1 release** • Enhanced transaction processing function • Onboarding and secure document store integrations	**1.2 release** • Public network integration

IBM Blockchain Platform Roadmap

Q1	Q2	Q3	Q4

• **Starter plan- beta**
  • Ideal for getting started with IBM Blockchain
  • Running Fabric 1.1 with CouchDB and Composer
  • Offered on IBM Cloud
• **Continued Enterprise Availability**
• **Enterprise+ Plan (limited availability)**
  • Highest levels of security, isolation and disaster recovery for regulated industries
• **Smart contracts and analytics tech preview**
  • Get insights from the ledger
	• **Enterprise** support for Fabric V1.1 with CouchDB and Composer
	• **IBM Blockchain Platform with IBM Cloud Private Beta**
	• **Enterprise+ GA**
	• **Industry samples and templates** for financial services, supply chain and energy and utilities
		• **On ramps for public blockchain networks** (first Stellar and then Hyperledger Indy)
		• **Network Registry**
		  • Find and join other blockchain networks
		• **Asset marketplace**
		  • Use APIs, templates and other applications to accelerate your blockchain project
		• **IBM Blockchain Platform with IBM Cloud Private GA**
		• **Multi-site Disaster Recovery**
		• **Zero knowledge proofs, SideDB and token capabilities**
		• **Global blockchain footprint expanding to 20+ data centers**
		  • IBP certified to ISO27001 industry standard compliance, SOC2 Type2 and HIPAA planned for 2H18	

Blockchain Network Finder



Discover other networks

Your idea

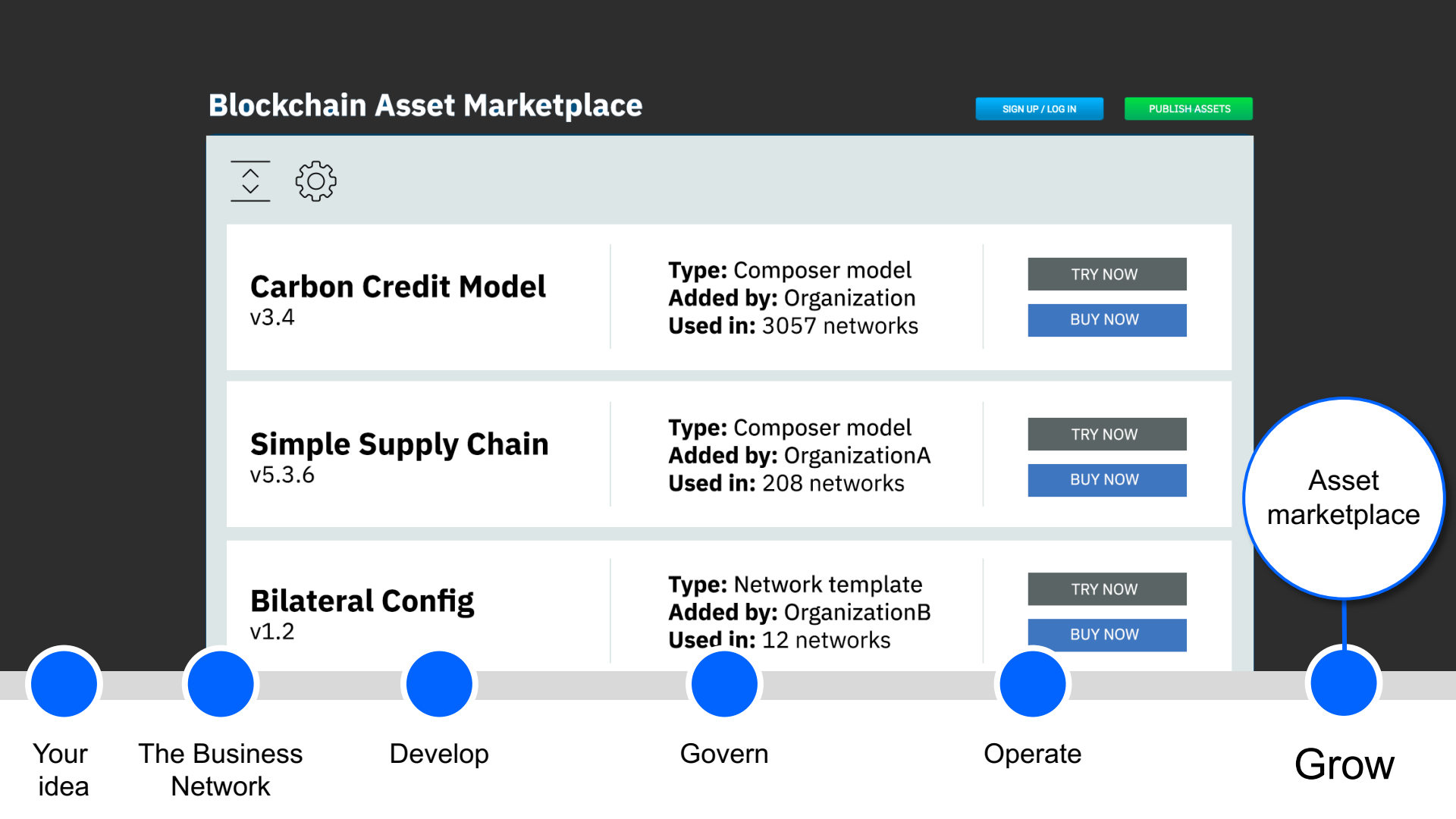
The Business Network

Develop

Govern

Operate

Grow


Blockchain Asset Marketplace
SIGN UP / LOG IN
PUBLISH ASSETS
Carbon Credit Model
v3.4
Type: Composer model
Added by: Organization
Used in: 3057 networks
TRY NOW
BUY NOW
Simple Supply Chain
v5.3.6
Type: Composer model
Added by: OrganizationA
Used in: 208 networks
TRY NOW
BUY NOW
Bilateral Config
v1.2
Type: Network template
Added by: OrganizationB
Used in: 12 networks
TRY NOW
BUY NOW
Asset marketplace
Your idea
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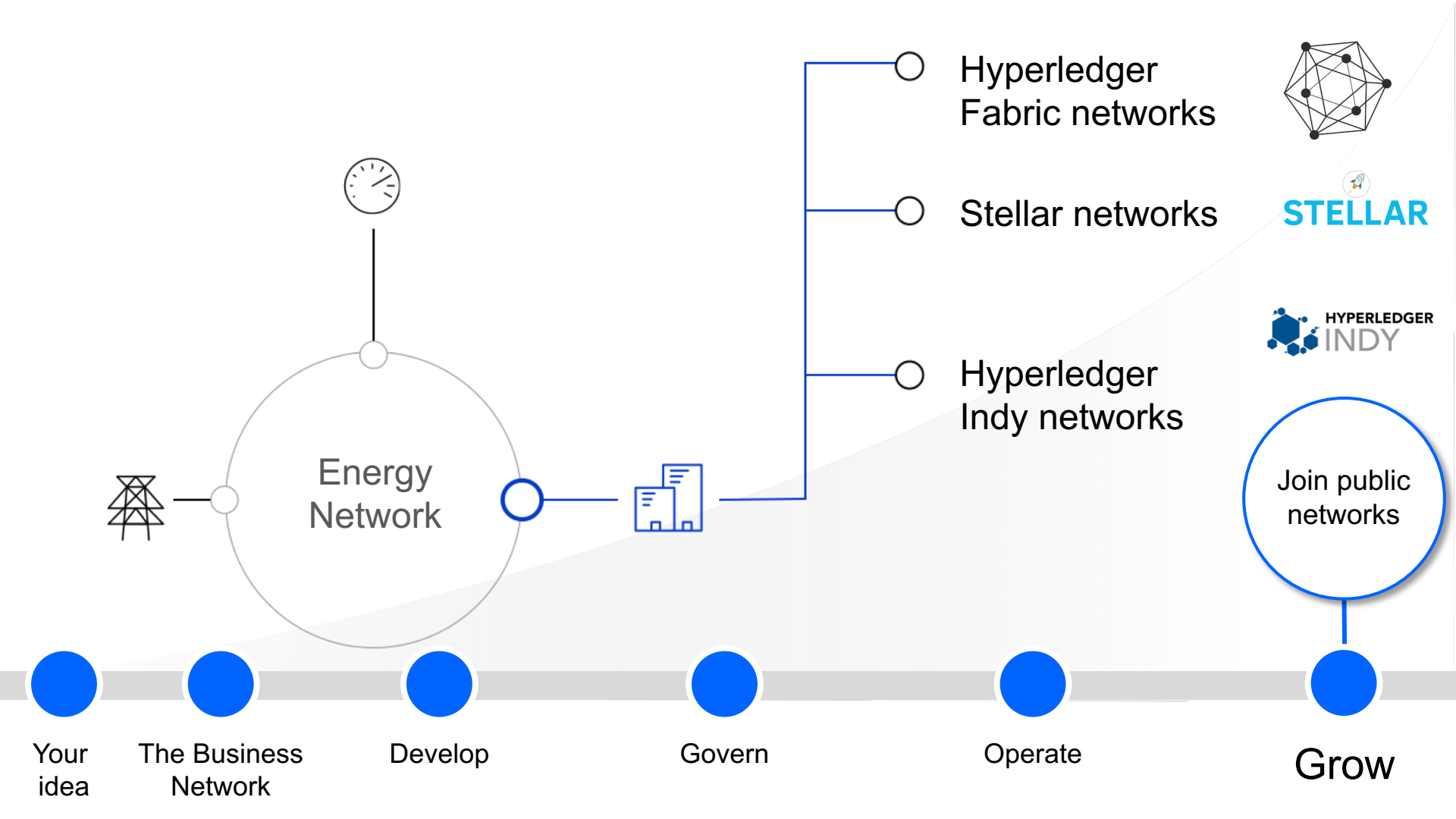
Hyperledger
Fabric networks
Stellar networks
STELLAR
HYPERLEDGER
INDY
Hyperledger
Indy networks
Energy
Network
Join public
networks
Your
idea
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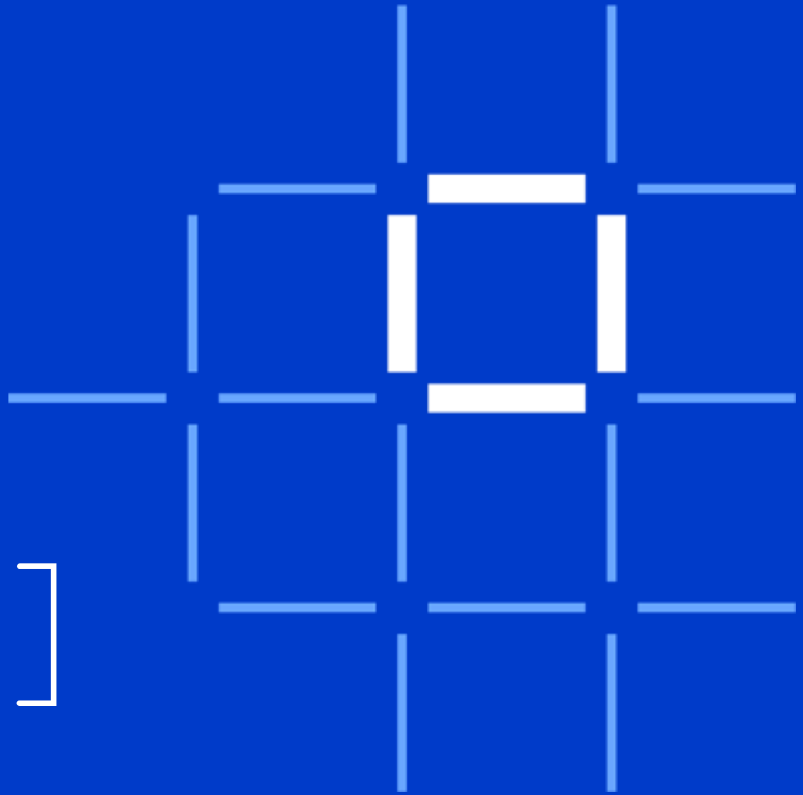
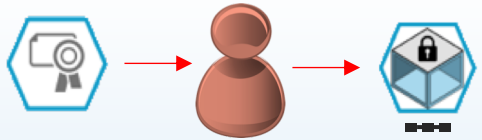


Blockchain Technical Concepts

Peers are the networked services that maintain ledger state and run smart contracts

Channels are defined subsets of the peer network that share a single ledger



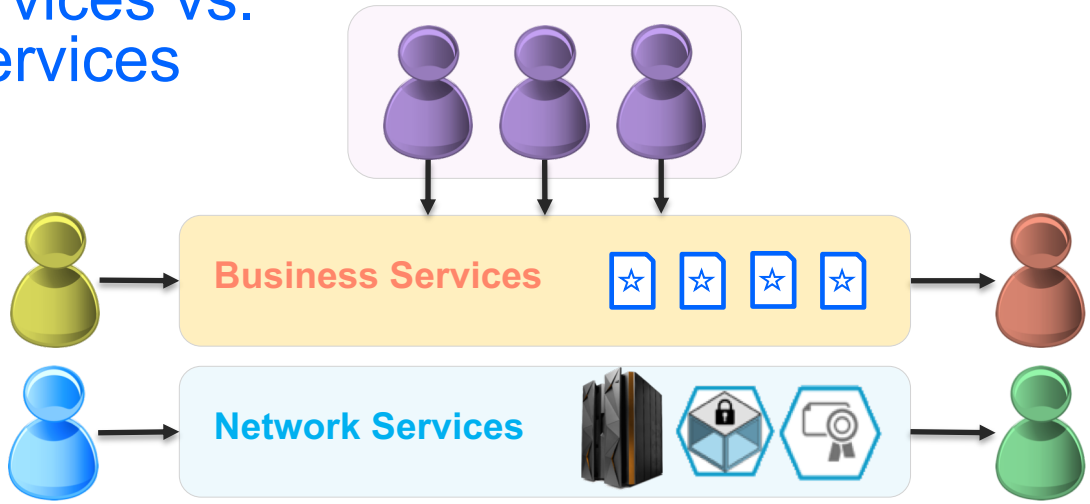
Certificate authorities provide identity services to participants on the network

Smart contracts constitute the transaction logic whose output is agreed by the peer network

Consensus is the process by which agreement is obtained on the peer network

The **Ordering Service** agrees transaction sequence and distributes blocks to peers

Network Services vs. Business Services



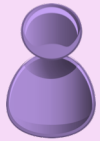
- A good enterprise architecture consists of Network Services and Business Services
  - Network Services provide a technical computing foundation
  - Business Services are an abstraction that provide meaningful business context

- A blockchain network also consists of Network Services and Business Services
  - Peers, Channels, Ordering Service, etc. are Network Services
  - Smart Contracts and the APIs that invoke them are Business Services

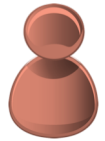
- Depending on their role, blockchain stakeholders each **provide** or **consume** these services…

Blockchain Participant Roles

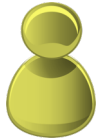
(A single organization may play multiple roles!)



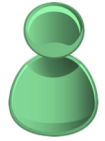
End-user **runs** presentation logic
(e.g. on mobile device or dashboard)



Business Service Consumer **hosts** application and integration logic which invoke blockchain transactions



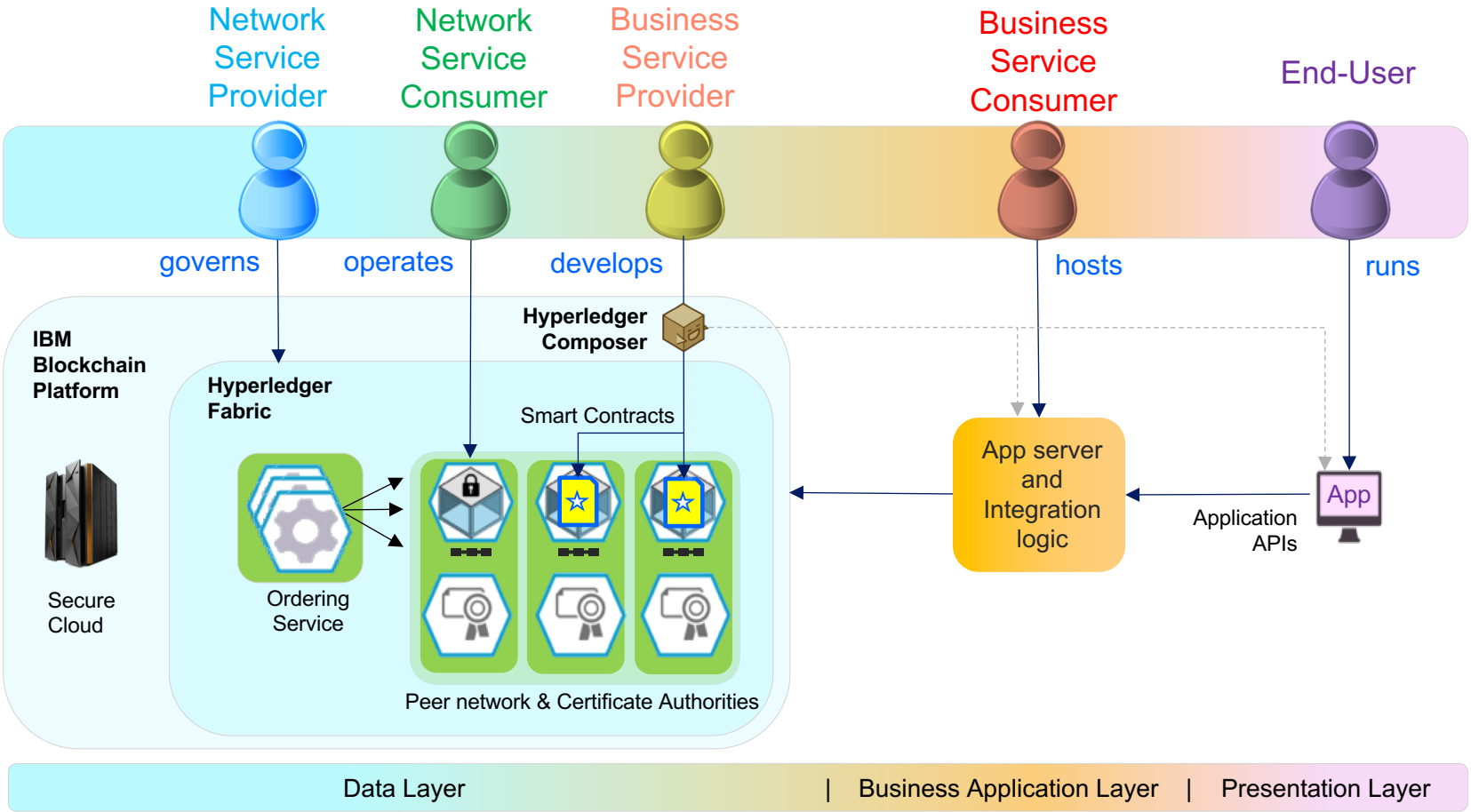
Business Service Provider **develops** blockchain business applications, including transaction, app server, integration and presentation logic



Network Service Consumer **operates** a set of peers and certificate authorities on the network; represents an organization on the business network

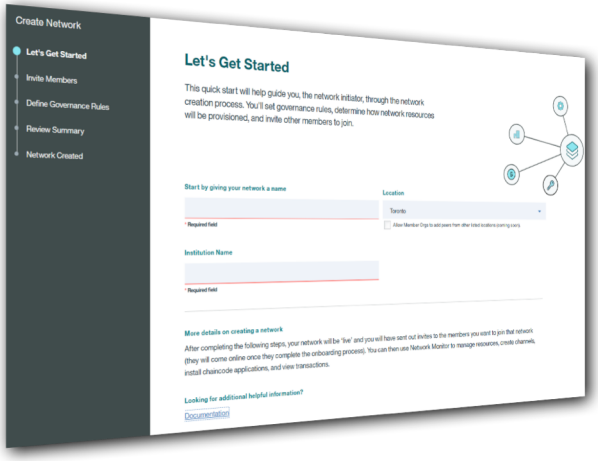
Network Service Provider **governs** changes to the network;
a consortium of network members or designated authority

Network Architecture and Participant Roles



IBM Blockchain Platform for Network Service Providers

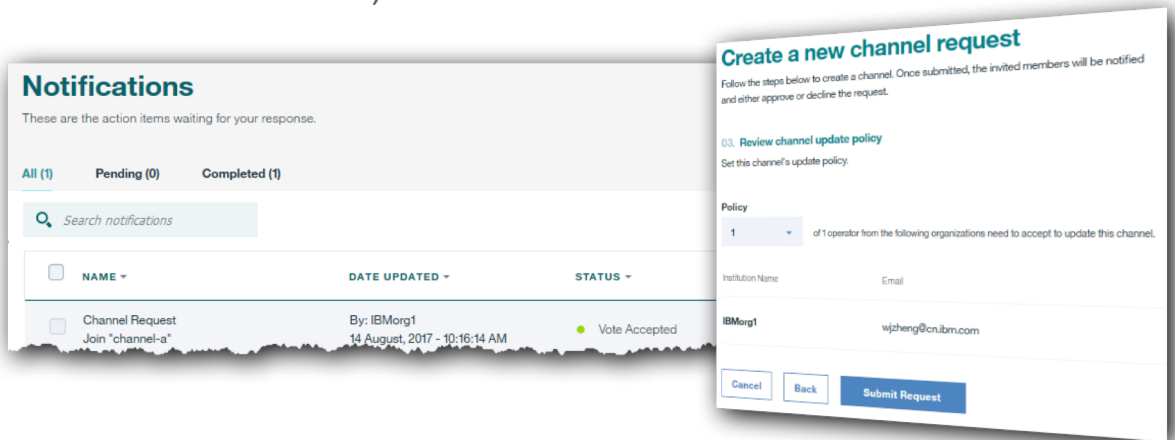
Governance of changes to the blockchain network



- Network Service Providers play a vital role in a blockchain network
  - Initiating the network
  - Creating membership, channel and smart contract policies

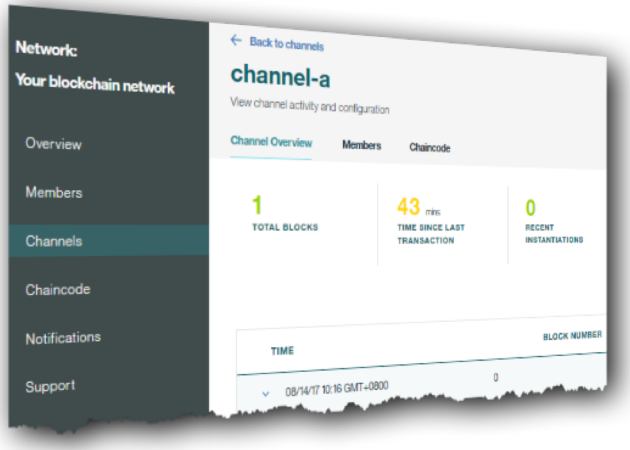
- Typically covers **changes to the network**; common recurring tasks (e.g. certificate management) are managed by Network Service Consumers
- Either centralized (e.g. industry regulator) or decentralized (e.g. members of a consortium)

- Democratic voting policies handled through Notifications UI
  - Accept/Reject proposals
  - Review completed items

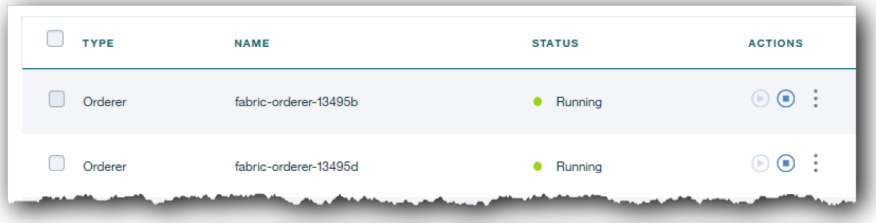


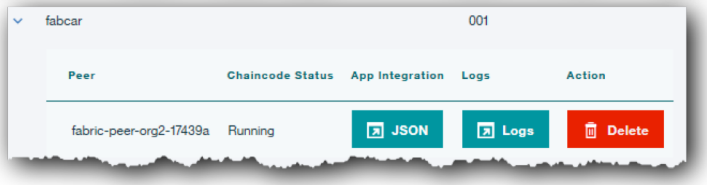
IBM Blockchain Platform for Network Service Consumers

Operate a subset of peers in a blockchain network



- Network Service Consumers operate an organization's peers and certificate authorities
  - Installing and instantiating smart contracts
  - Managing certificates for Business Service Consumers in their organization
  - Monitoring network resources
  - Creating channels (in accordance with defined policies)

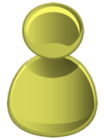




- All administrative tasks accessible through web UI
  - Covers members, channels, smart contracts…
  - Full access to APIs and logs for transparent problem determination

IBM Blockchain Platform for Business Service Providers

Develop blockchain applications



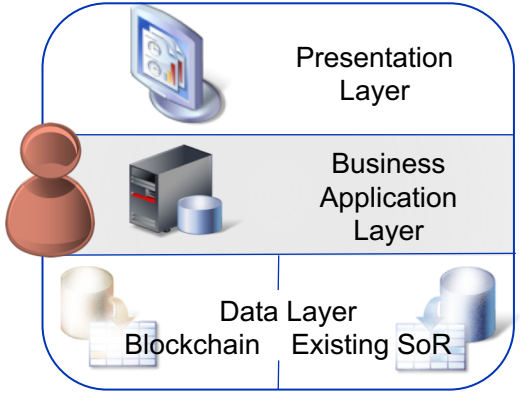
- A blockchain application consists of three components:
  - **Smart contracts**: transaction logic run on the distributed peer network (e.g. Composer BNA file)
  - **Business logic**: business applications and integration services that invoke smart contracts
  - **Presentation logic**: client applications run by end-users of the system

- The role of Business Service Providers is to develop these components
  - Separation of concerns between business logic and blockchain network (the what and the where)

  - **Hyperledger Composer** comprises a set of tools for rapid blockchain application development
    - Smart contracts: deployed to the IBM Blockchain Platform as chaincode
    - Business logic: deployed to application server/integration tier
    - Presentation logic: made available to end-users

The role of Business Service Consumers

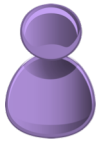
Host applications and integration services that invoke smart contracts



- Business Service Consumers are typically responsible for two things:
  - Hosting business logic that invokes smart contracts running on IBM Blockchain Platform
  - Managing End-User identity
- Business logic is **hosted on an application server**
  - Either off-premises (e.g. IBM Cloud) or on-premises
  - Typically connect via integration middleware (e.g. IBM Integration Bus)
- Invokes appropriate APIs to invoke smart contracts in the usual way
  - End-users authenticate and cause blockchain transactions to be invoked using a proxy identity provided by the Network Service Consumer's certificate authority
  - Multiple applications can interact with the same blockchain
- Consider implementing a **shadow chain** and running existing systems of record in parallel
  - Allows for staged onboarding of new members and mitigation of risk

How End-Users interact with the blockchain

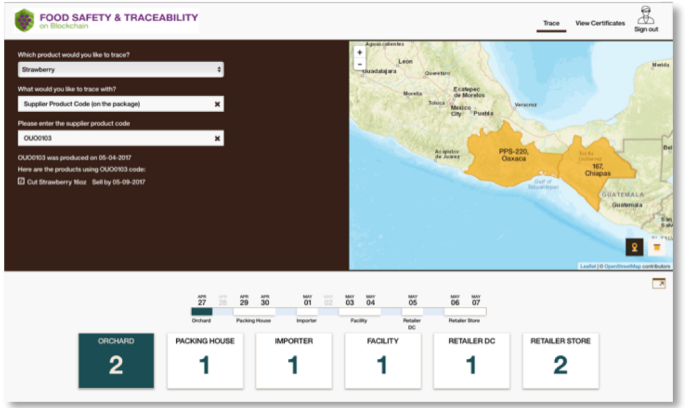
Exchange trustworthy information



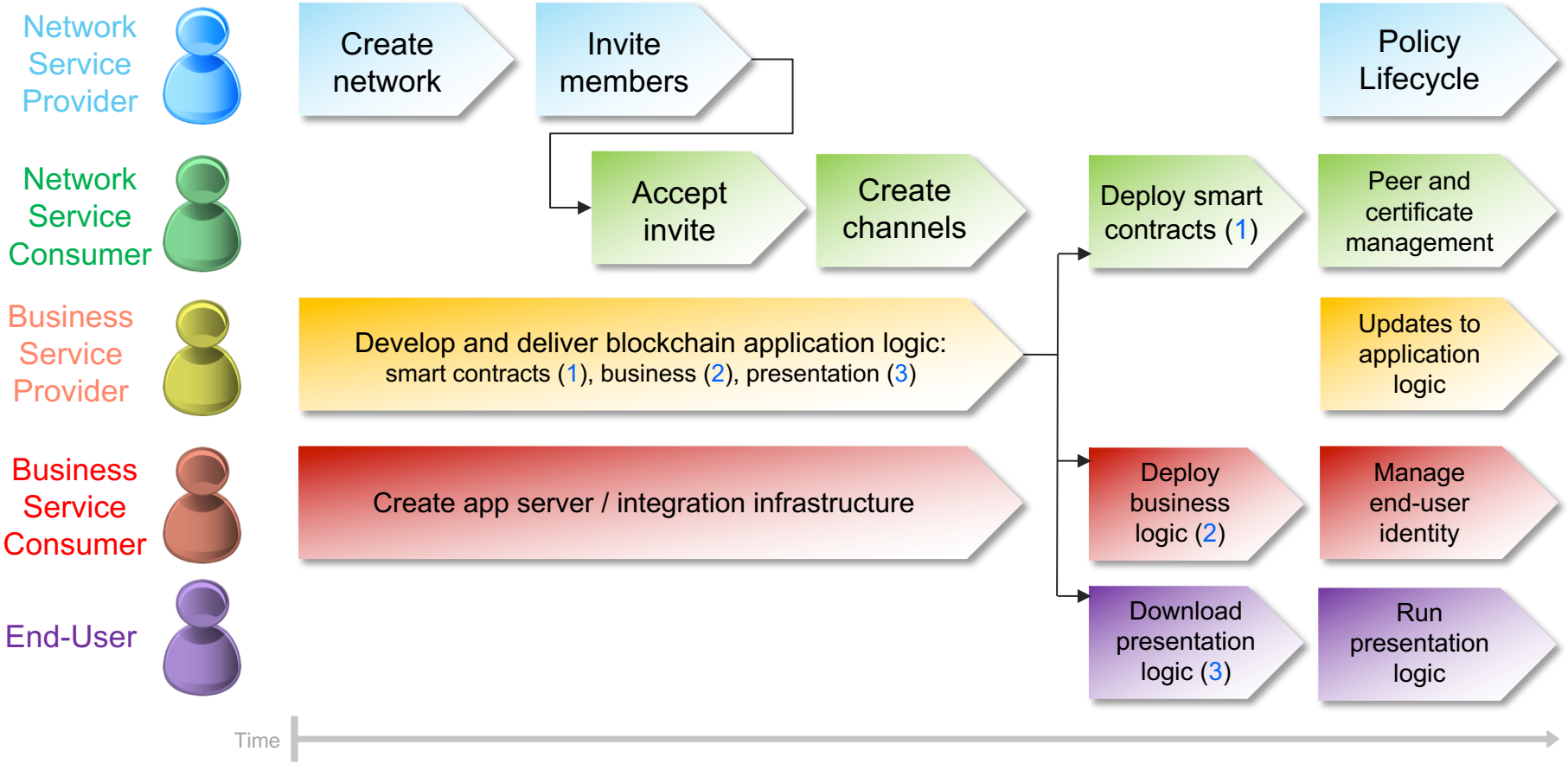
- End-users run presentation logic on an appropriate device
  - For example, mobile application or desktop dashboard
  - There may be multiple end-user applications (often one per organization or user role)

- The value proposition to end-users is that the information they see is **trustworthy**
  - Will probably be unaware of blockchain back-end
  - Uses an identity managed by the business application layer

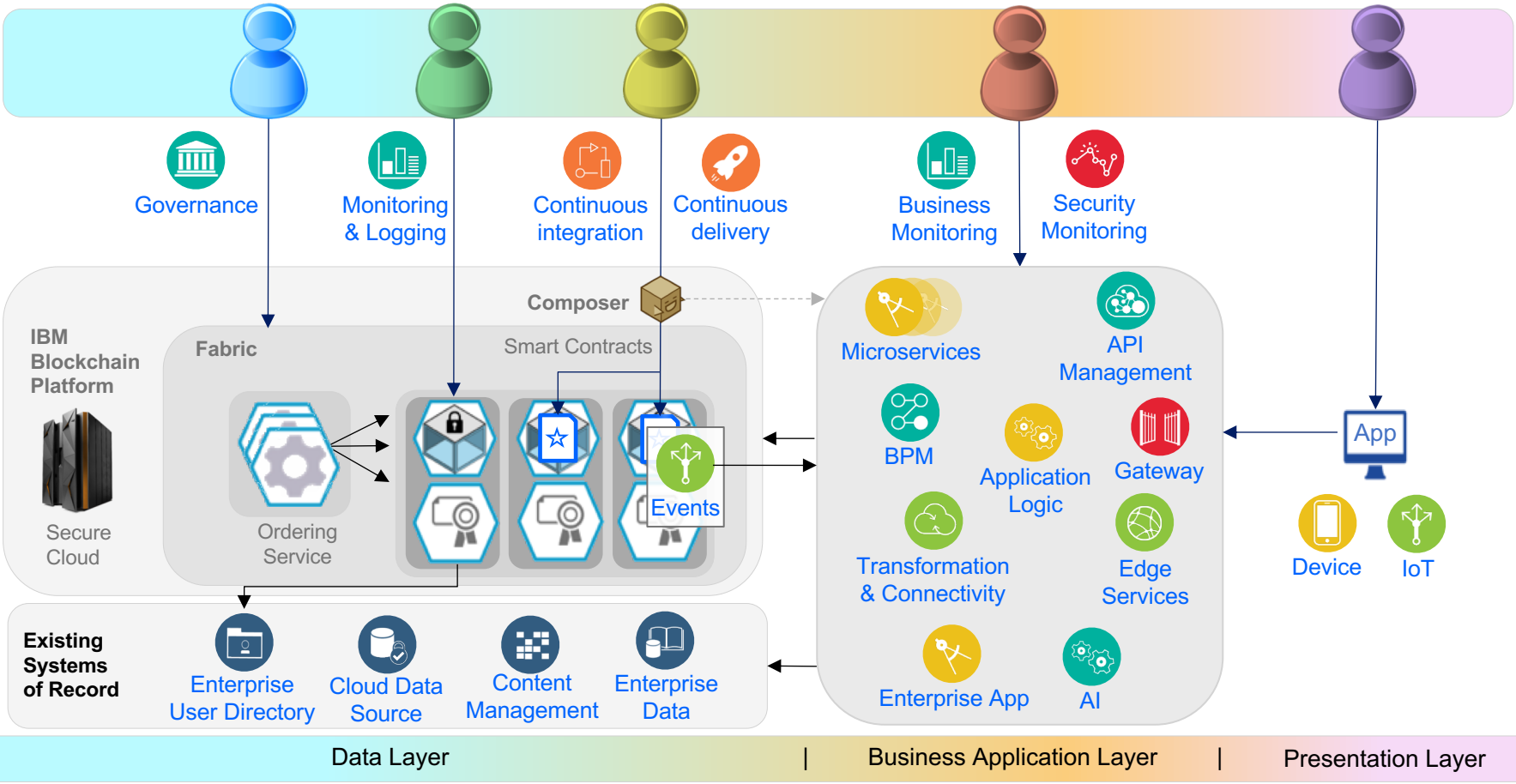
- Many options for presentation logic implementation
  - IBM Blockchain Platform can use Hyperledger Composer to generate skeleton Angular or command-line applications
  - Application usually interacts with the business logic layer via REST



Workflow for Network Formation



How the architecture fits with enterprise services and processes



Security is implemented at each layer of the architecture

Secure Hardware

Hardware Security Module

Encrypted Storage

Secure Services Containers

Membership Services

Secure Comms

Consensus

Hyperledger Fabric

Security is implemented at each layer of the architecture

- Hyperledger Fabric
  - Membership Services: Organizations are invited to join and authenticated using an Enrollment Certificate
  - Transaction Consensus: Each transaction is endorsed and validated by multiple peers before committing to the ledger
  - Controlled Ledger Access: Channels restrict transactions to a set of organizations that are shared on the ledger
  - Secure Communications: Between the end-user application and smart contract is secure
  - Extensive security scans and audits performed by IBM, and independently by IBM and Linux Foundation sponsored 3rd-party penetration testing and code audits

- Secure Service Containers
  - Secure appliance framework providing infrastructure services encapsulating the Hyperledger Fabric
  - No root access: Access system and software only through API's; even trusted administrators
  - Impervious to the injection of malware: Installed from encrypted, signed boot image
  - Data Privacy: Encryption of data in flight and at rest on the ledger

- Secure Performant Hardware
  - Keys stored in HSM certified to FIPS 140-2 level 4
  - Fastest cryptographic acceleration: used by block hashing and digital signatures

Continuing your blockchain journey…

Business Stakeholder

- Request a business value assessment from IBM
- Prove out technology with a first project

Blockchain BVA

Solution Architect

- Learn about blockchain use-cases and references
- Understand blockchain solution best practices

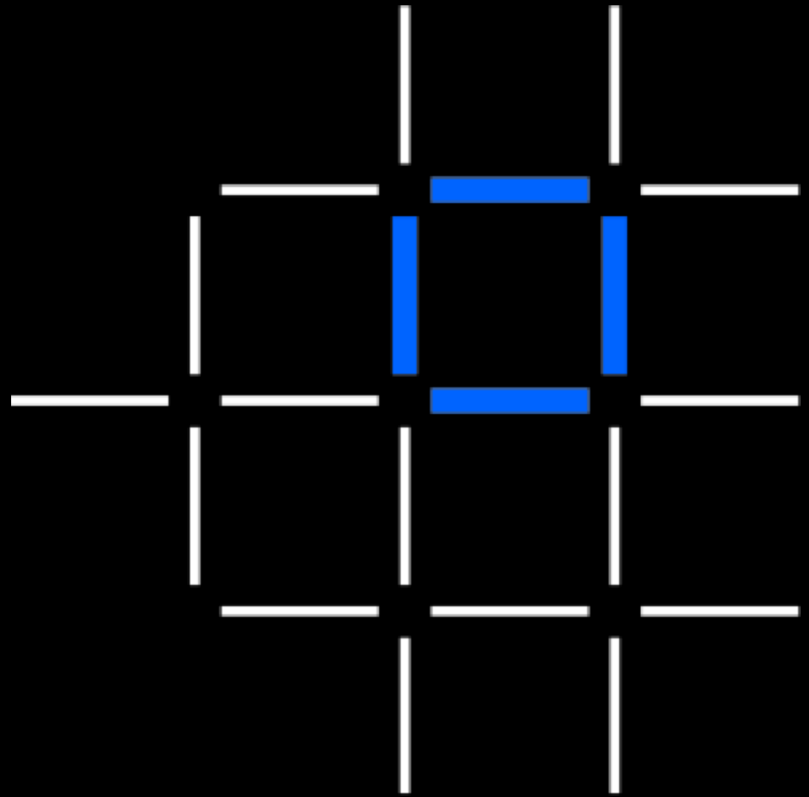
Blockchain Solutions

Developer

- Play with IBM Blockchain Developer Tools
- Learn about Hyperledger Composer

Blockchain Composed

Thank you



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