Blockchain Composed

A Technical Introduction to Hyperledger Composer

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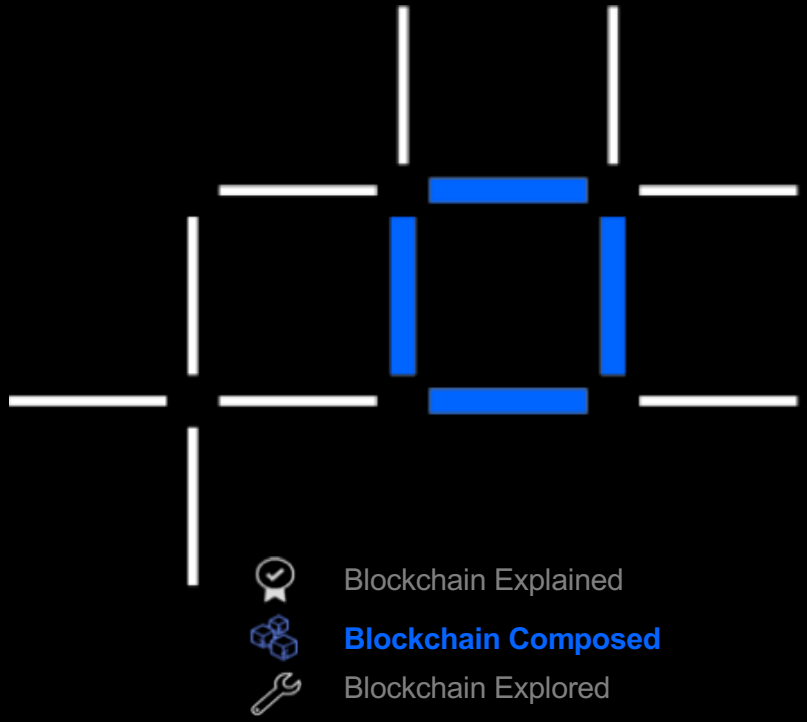

January 25, 2018

IBM **Blockchain**

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What is Hyperledger Composer?

Application Development

Writing the application
Modeling the business network

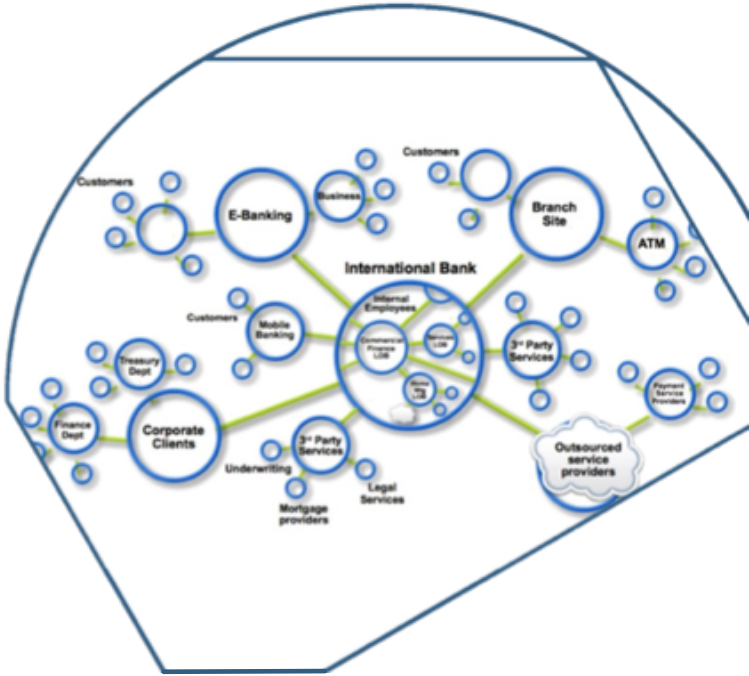
Effective Administration

Deploying to a blockchain
Interacting with systems of record

Blockchain Recap

- Blockchain builds on basic business concepts
  - **Business Networks** connect businesses
  - **Participants** with Identity
  - **Assets** flow over business networks
  - **Transactions** describe asset exchange
  - **Contracts** underpin transactions
  - The **ledger** is a log of transactions

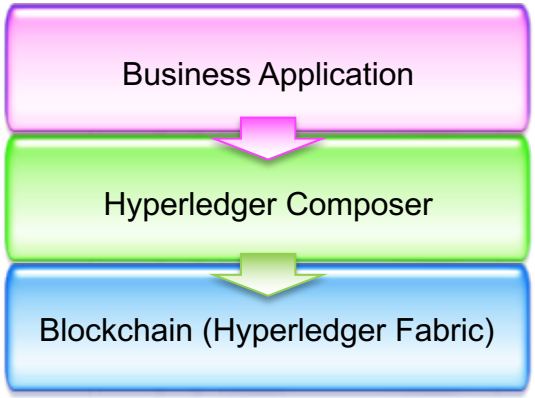
- Blockchain is a shared, replicated ledger
  - Consensus, immutability, finality, provenance

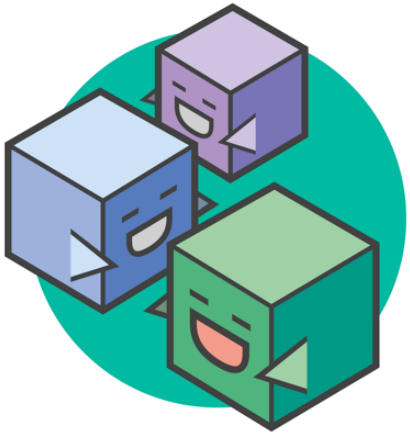


Hyperledger Composer: Accelerating time to value

https://hyperledger.github.io/composer/

- A suite of high level application **abstractions** for business networks
- Emphasis on business-centric vocabulary for quick solution creation
- Reduce risk, and increase understanding and flexibility





- Features
  - Model your business networks, test and expose via APIs
  - Applications invoke APIs transactions to interact with business network
  - Integrate existing systems of record using loopback/REST
- Fully open and part of Linux Foundation Hyperledger
- Try it in your web browser now: http://composer-playground.mybluemix.net/

Benefits of Hyperledger Composer

Increases understanding

Bridges simply from business concepts to blockchain

Saves time

Develop blockchain applications more quickly and cheaply

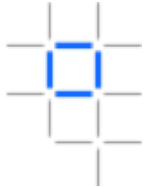
Reduces risk

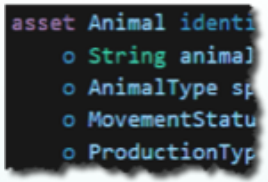
Well tested, efficient design conforms to best practice

Increases flexibility

Higher level abstraction makes it easier to iterate

Extensive, Familiar, Open Development Toolset





Data modelling

JavaScript business logic

Web playground

Client libraries

Editor support

CLI utilities

Code generation

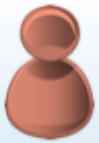
Existing systems and data

User Roles in a Blockchain Project

- Network Provider
  - **Governs** the network: channels, membership etc.
  - A consortium of network members or designated authority

- Network Consumer
  - **Operates** a set of peers and certificate authorities on the network
  - Represents an organization on the business network

- Developer
  - **Develops** blockchain business applications
  - Includes transaction, app server, integration and presentation logic



- Business Consumer
  - Hosts application and integration logic which invokes blockchain transactions

- End-user
  - Runs presentation logic e.g. on mobile device or dashboard

A single organization may play multiple roles!

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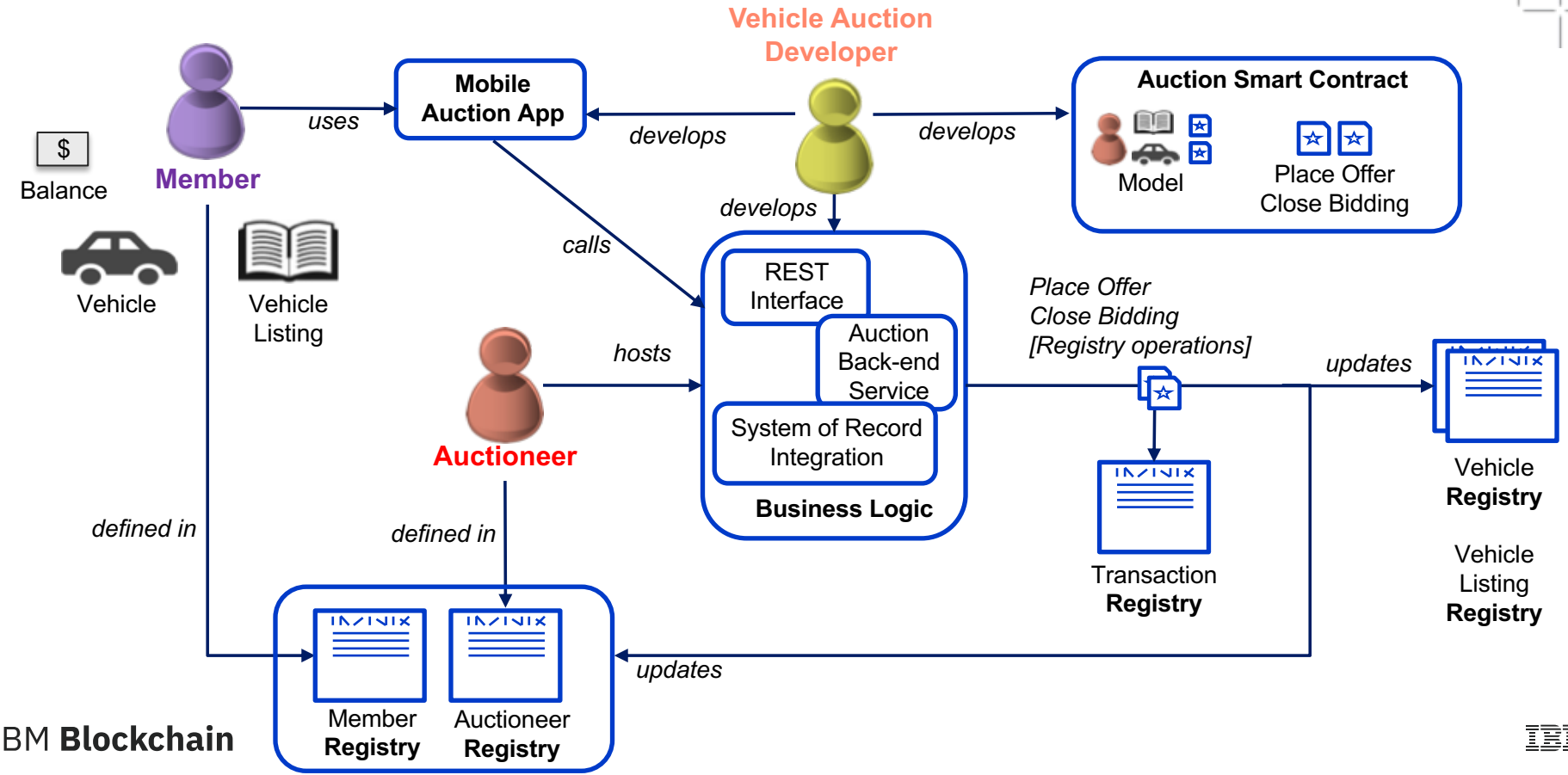
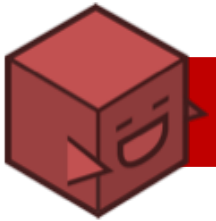
Key Concepts for a Vehicle Auction Developer



The Developer's three components

Smart Contracts

- Implements the logic deployed to the blockchain
  - **Models** describe assets, participants & transactions
  - **Transaction processors** provide the JavaScript implementation of transactions
  - **ACLs** define privacy rules
  - May also define events and registry queries



Business Logic

- **Services** that interact with the registries
  - Create, delete, update, query and invoke smart contracts
  - Implemented inside business applications, integration logic and REST services
- Hosted by the Business Consumer

Presentation Logic

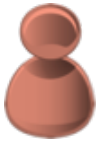
- Provides the **front-end** for the end-user
  - May be several of these applications
- Interacts with business logic via standard interfaces (e.g. REST)
- Composer can generate the REST interface from model and a sample application

Assets, Participants and Transactions

Vehicle

Vehicle Listing

Member



Auctioneer

Place Offer
Close Bidding

```
asset Vehicle identified by vin {
  o String vin
  --> Member owner
}
```

```
asset VehicleListing identified by listingId {
  o String listingId
  o Double reservePrice
  o String description
  o ListingState state
  o Offer[] offers optional
  --> Vehicle vehicle
}
```

```
abstract participant User identified by email {
  o String email
  o String firstName
  o String lastName
}

participant Member extends User {
  o Double balance
}

participant Auctioneer extends User {
}
```

```
transaction Offer {
  o Double bidPrice
  --> VehicleListing listing
  --> Member member
}

transaction CloseBidding {
  --> VehicleListing listing
}
```

Transaction Processors

```
/**
 * Close the bidding for a vehicle listing and choose the
 * highest bid that is
 * @param {org.acme.ve
 * @transaction
 */
function closeBidding(
    var listing = clos
    if (listing.state
```

```
/**
 * Make an Offer for a VehicleListing
 * @param {org.acme.vehicle.auction.Offer} offer - the offer
 * @transaction
 */
function makeOffer(offer) {
    var listing = offer.listing;
    if (listing.state !== 'FOR_SALE') {
```

IBM **Blockchain**

Access Control

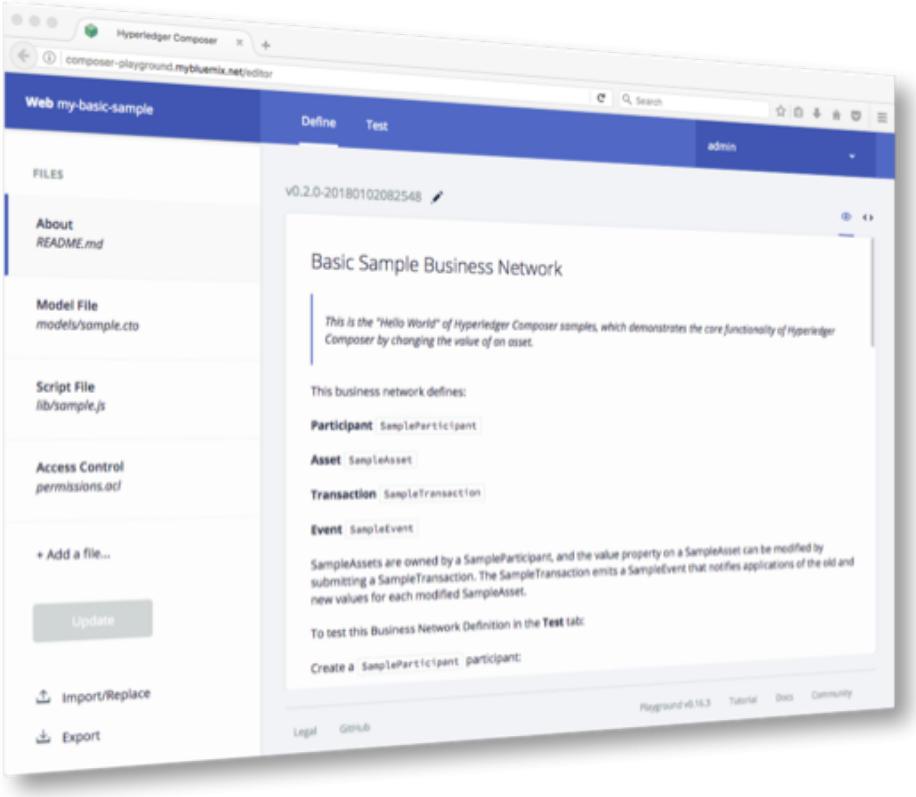
```
rule EverybodyCanReadEverything {
    description: "Allow all participants read access to all resources"
    participant: "org.acme.sample.SampleParticipant"
    operation: READ
    resource: "org.acme.sample.*"
    action: ALLOW
}
```

```
rule OwnerHasFullAccessToTheirAssets {
    description: "Allow all participants full access to their assets"
    participant(p): "org.acme.sample.SampleParticipant"
    operation: ALL
    resource(r): "org.acme.sample.SampleAsset"
    condition: (r.owner.getIdentifier() === p.getIdentifier())
    action: ALLOW
}
```

```
rule SystemACL {
  description:  "System ACL to permit all access"
  participant: "org.hyperledger.composer.system.Participant"
  operation: ALL
  resource: "org.hyperledger.composer.system.**"
  action: ALLOW
}
```

- It is possible to restrict which resources can be read and modified by which participants
  - Rules are defined in an .acl file and deployed with the rest of the model
  - Transaction processors can also look up the current user and implement rules programmatically
- ACL rules can be simple (e.g. everybody can read all resources) or more complex (e.g. only the owner of an asset can do anything to it)
- Application supplies credentials (userid/secret) of the participant when connecting to the Fabric network
  - This also applies to Playground!
  - Remember to grant System ACL all access if necessary

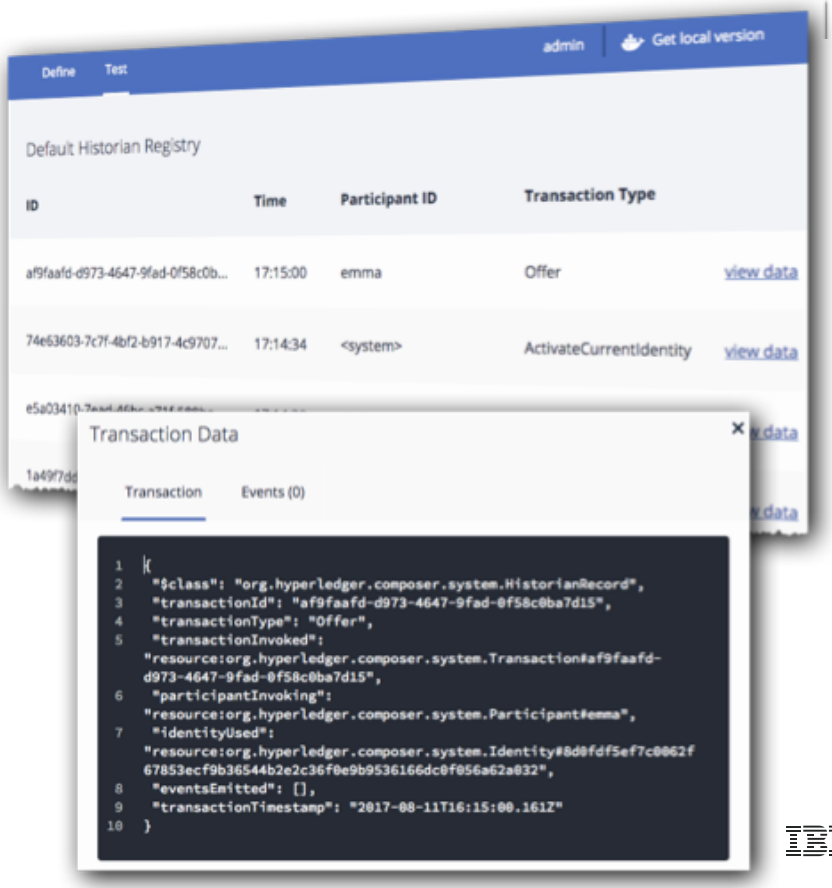
Smart Contract Development: Composer Playground



- Web tool for defining and testing Hyperledger Composer models and scripts
- Designed for the application developer
  - Define assets, participants and transactions
  - Implement transaction processor scripts
  - Test by populating registries and invoking transactions
- Deploy to instances of Hyperledger Fabric V1, or simulate completely within browser
- Install on your machine or run online at http://composer-playground.mybluemix.net

Debugging

- Playground Historian allows you to view all transactions
  - See what occurred and when
- Diagnostics framework allows for application level trace
  - Uses the *Winston* Node.js logging framework
  - Application logging using DEBUG env var
  - Composer Logs sent to stdout and ./logs/trace_<processid>.trc
- Fabric chaincode tracing also possible
- More information online: https://hyperledger.github.io/composer/problems/diagnostics.html



What is Hyperledger Composer?

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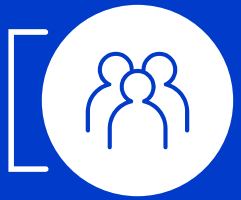
Modeling the business network



Effective Administration

Deploying to a blockchain
Interacting with systems of record

There are Two User Roles with “Administration” Responsibility

- Network Provider
  - **Governs** the network: channels, membership etc.
  - A consortium of network members or designated authority

- Network Consumer
  - **Operates** a set of peers and certificate authorities on the network
  - Represents an organization on the business network

- Developer
  - **Develops** blockchain business applications
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- Business Consumer
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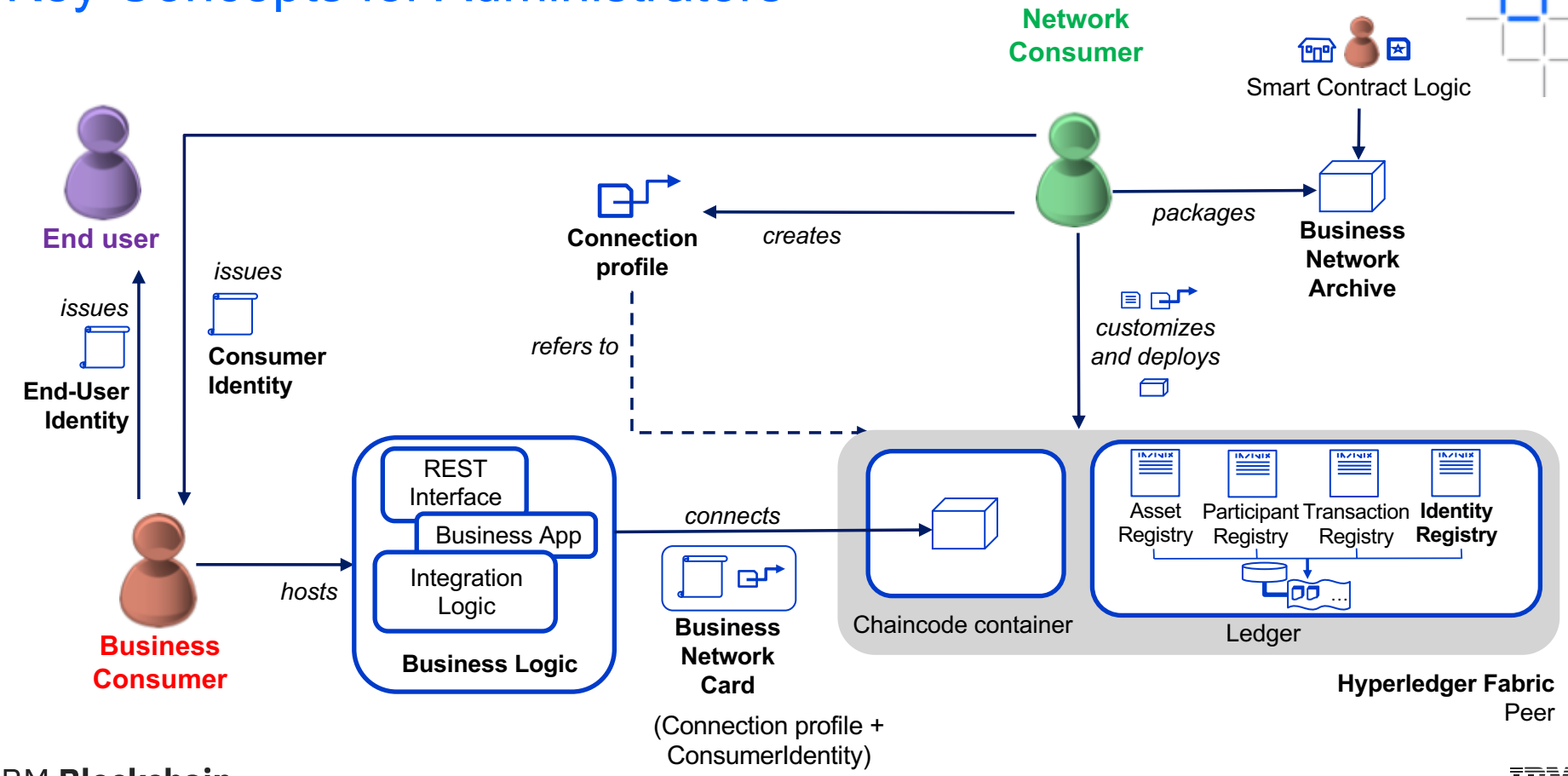
A single organization may play multiple roles!

Key Concepts for Administrators

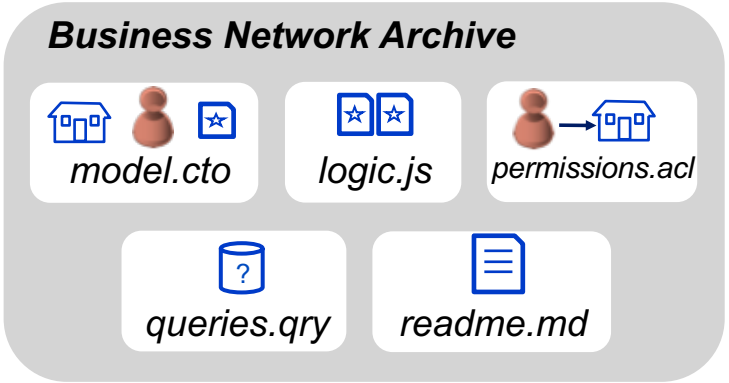


The Network Consumer packages resources into a BNA file

- Business Network Archive (.BNA) is a package of the resources used by Fabric:
  - Model files (.CTO)
  - Transaction processors (.JS)
  - Access Control Lists (.ACL)
  - Static queries (.QRY)
  - Documentation and versioning (.MD)
  - It does *not* contain the client application

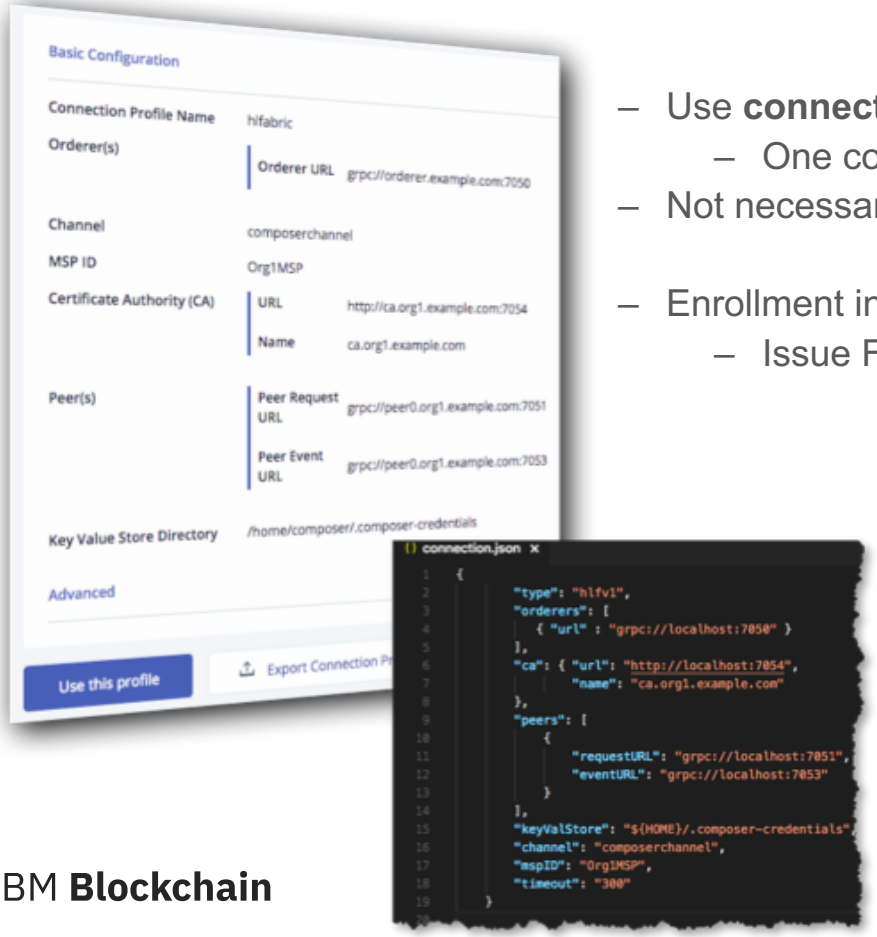
- The BNA simplifies deployment of blockchain and promotion between environments
  - c.f. TAR, WAR, EAR, JAR, BAR…

- Create BNA files from Playground or command line
  - Build from filesystem or NPM module




```
composer archive create –archiveFile my.bna
      --sourceType module --sourceName myNetwork
```

Connection Profiles to Hyperledger Fabric



- Use **connection profiles** to describe Fabric connection parameters
  - One connection profile required per channel
- Not necessary for web-based simulation

- Enrollment in Hyperledger Fabric network required
  - Issue Fabric identity from Composer participants

- Connection profiles currently used by Composer only
  - Plans to implement common connection profiles that can be used by both Fabric and Composer

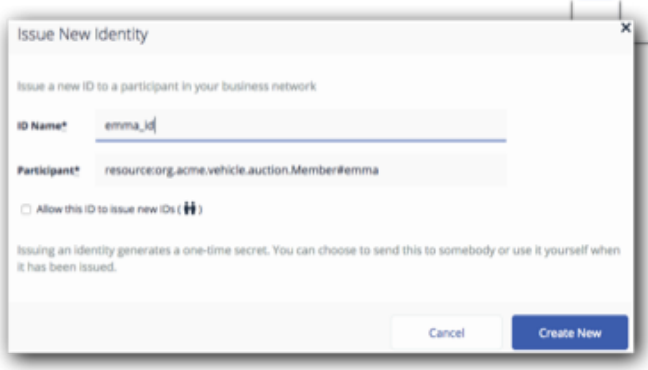
Participant Identity

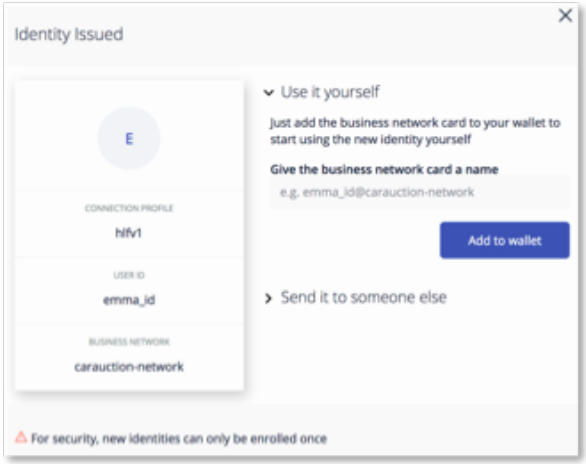
- The Network Consumer issues network participants with an **identity** in order to connect to Hyperledger Fabric
  - Issued as a Hyperledger Fabric userid/secret
  - Automatically swapped for a certificate on first use
  - Packaged in a Business Network Card and supplied when the client application connects

- Composer Participant to Fabric Identity mapping is stored on the blockchain in an *identity registry*

- Usually, only Business Consumers have a Fabric identity
  - End-users log in to the business application using a separately managed identity; blockchain transactions invoked by proxy

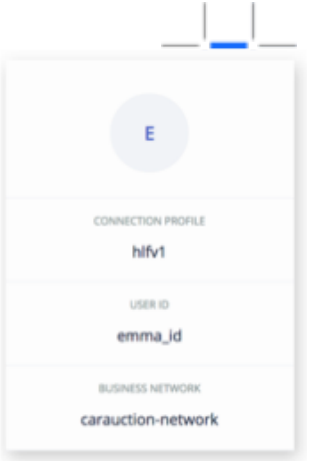
- Manage identity from Playground, Javascript, REST or command line
  - For example: Test connection, issue identity, bind an identity to a participant, revoke an identity, list identities

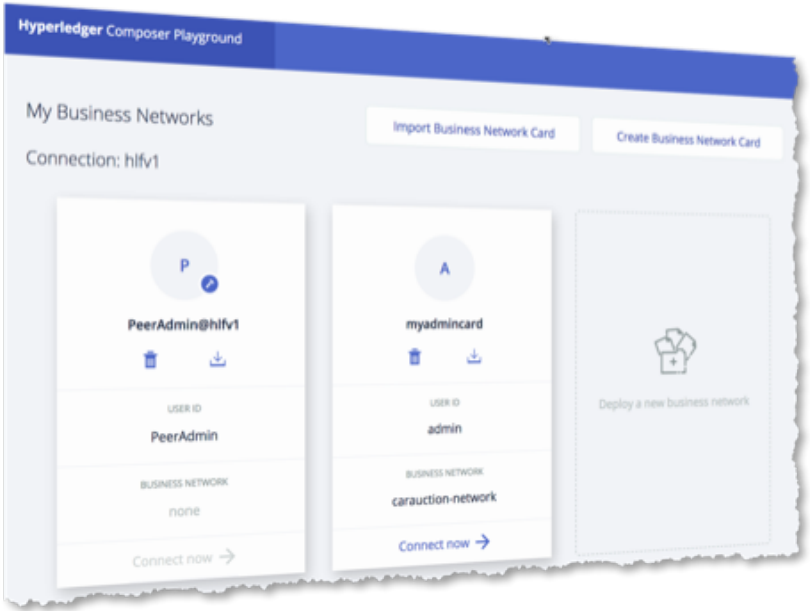




Business Network Cards

- Business Network Cards are a convenient packaging of *identity* and *connection profile*
  - Contains everything you need to connect to blockchain business network
  - Each card refers to a single participant and single business network
  - Analogous to an ATM card





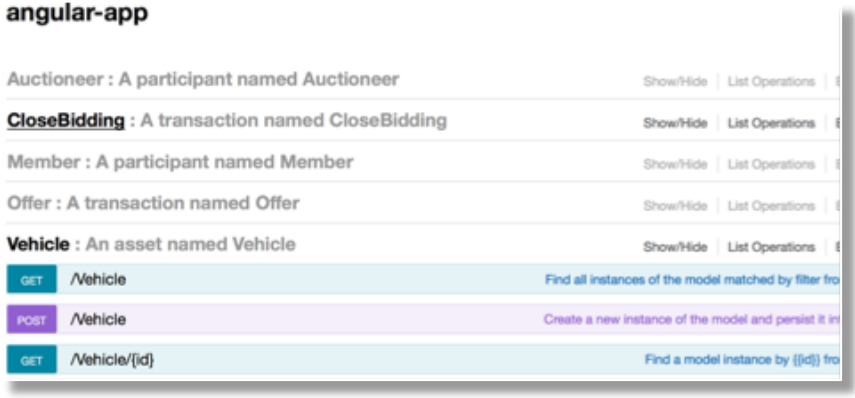
- Manage cards from both Playground and command-line
  - Create, delete, export, import, list
  - Create requires userid/secret or certificate/private key
- Use cards to connect to Fabric from Playground, command-line or from within your application

```
composer network deploy -a my.bna -c my.card
```

```
// Connect and log in to HLF
var businessNetwork = new BusinessNetworkConnection();
return businessNetwork.connect('cardName')
.then(function(businessNetworkDefinition){
    // Connected
});
```

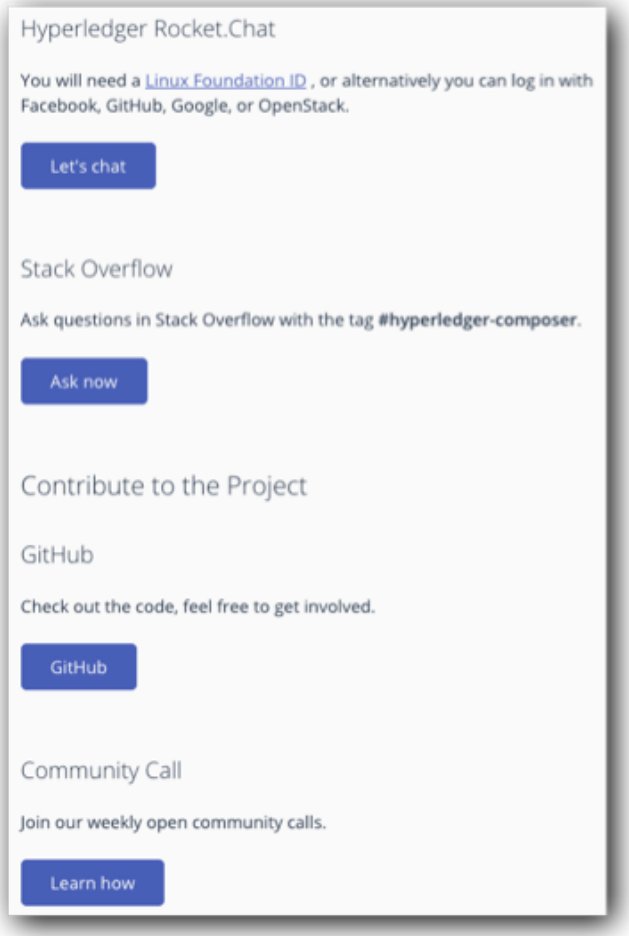
Systems of Record Integration

- Domain specific APIs very attractive to mobile and web developers. Resources and operations are business-meaningful
- Composer exploits Loopback framework to create REST APIs: https://loopback.io/
- Extensive test facilities for REST methods using loopback
- Secured using JS Passport, giving >400 options for authentication
- Composer provides back-end integration with any loopback compatible product
  - e.g. IBM Integration Bus, API Connect, StrongLoop
  - Outbound and Inbound (where supported by middleware)



Hyperledger Composer Outlook

- Still early in product lifecycle
- Lots of improvements planned
  - See https://github.com/hyperledger/composer/issues
- An active development community
  - Open community calls every two weeks
  - Rocket Chat
  - Stack Overflow
- Get involved!



Get started with Hyperledger Composer

– Define, Test and Deploy Business Networks

– Create domain APIs and sample applications

– Integrate existing systems and data

https://hyperledger.github.io/composer/

http://composer-playground.mybluemix.net/

Thank you

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IBM Blockchain

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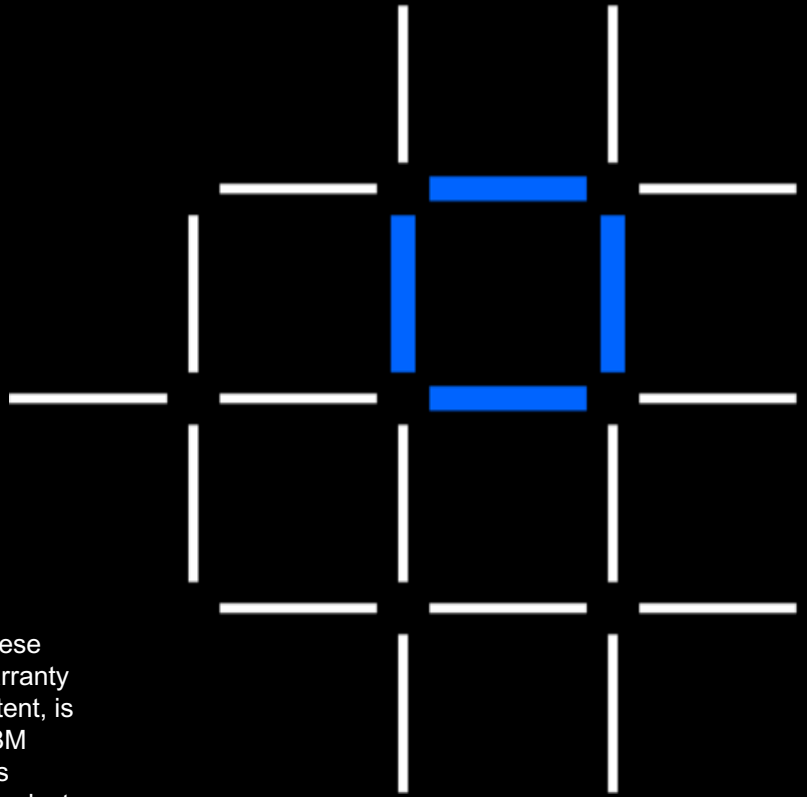

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