

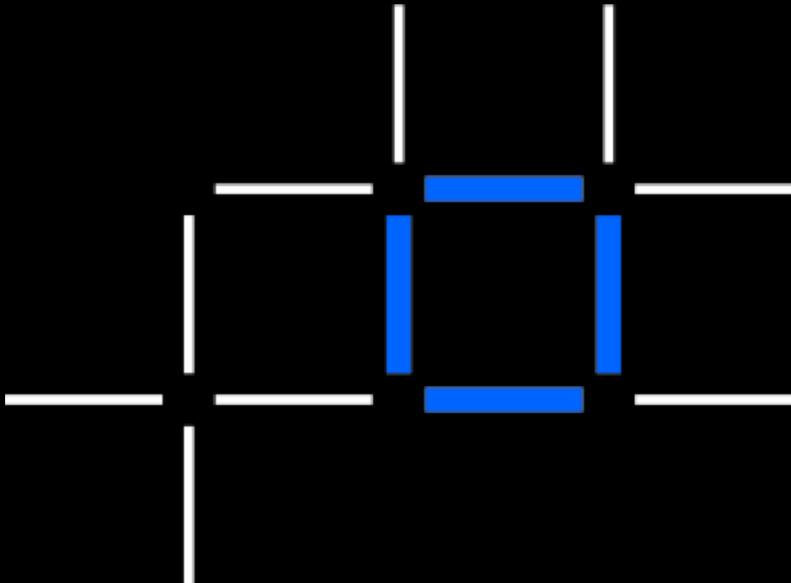
Blockchain Composed

A Technical Introduction to Hyperledger Composer

Austin Grice

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Blockchain Leader



Blockchain Composed



What is Hyperledger Composer?



Application Development

Writing the application

Modeling the business network



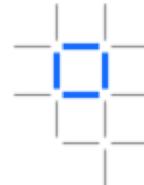
Effective Administration

Deploying to a blockchain

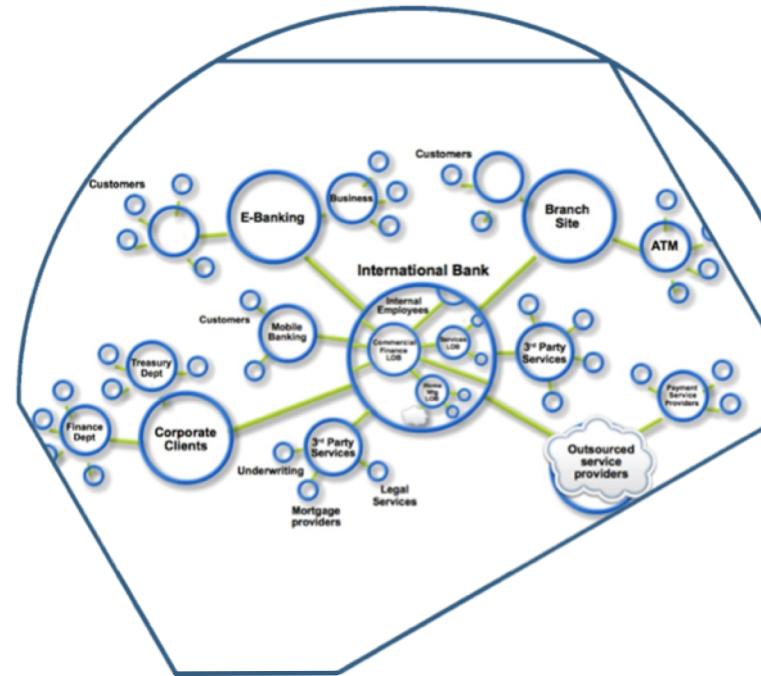
Interacting with systems of record



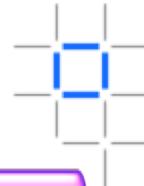
Blockchain Recap



- 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

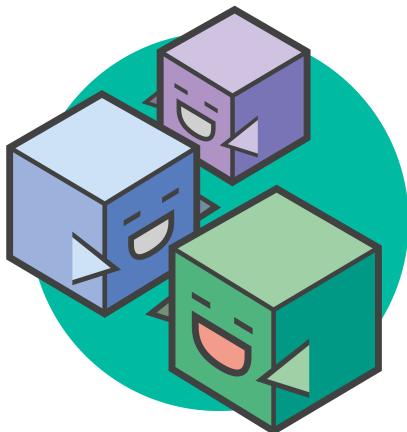


Hyperledger Composer: Accelerating time to value

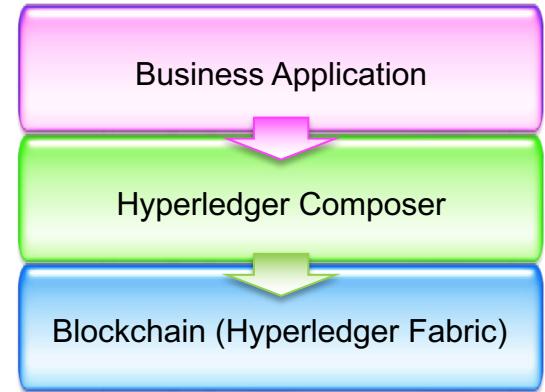


<https://hyperledger.github.io/composer/>

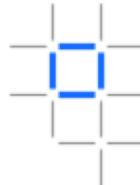
- A suite of high level application **abstractions** for business networks
- Emphasis on business-centric vocabulary for quick solution creation
- Reduce risk, and increase understanding and flexibility



- 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/>

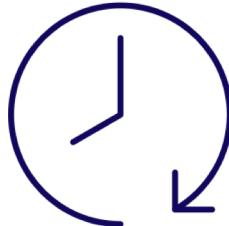


Benefits of Hyperledger Composer



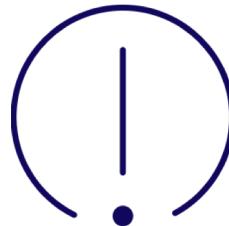
Increases understanding

Bridges simply from business concepts to blockchain



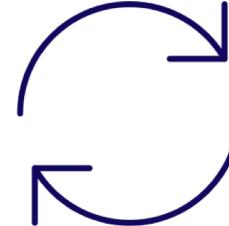
Saves time

Develop blockchain applications more quickly and cheaply



Reduces risk

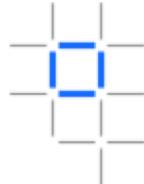
Well tested, efficient design conforms to best practice



Increases flexibility

Higher level abstraction makes it easier to iterate

Extensive, Familiar, Open Development Toolset

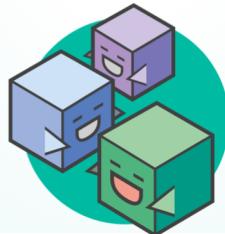


```
asset Animal identi  
  o String animal]  
  o AnimalType sp  
  o MovementStatus  
  o ProductionTyp
```

Data modelling



JavaScript
business logic



Web playground

composer-client
composer-admin



Client libraries



Editor support

\$ composer

CLI utilities



Code generation

Powered by
 LoopBack
Node.js Framework



Swagger

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



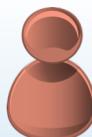
- Network Consumer

- **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!



What is Hyperledger Composer?



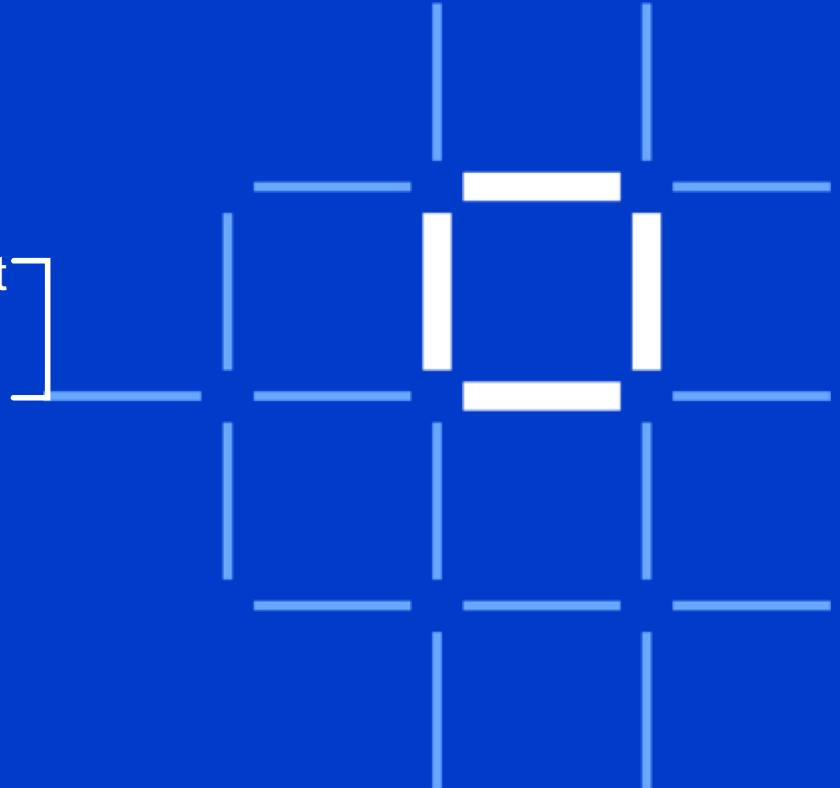
Application Development

*Writing the application
Modeling the business network*

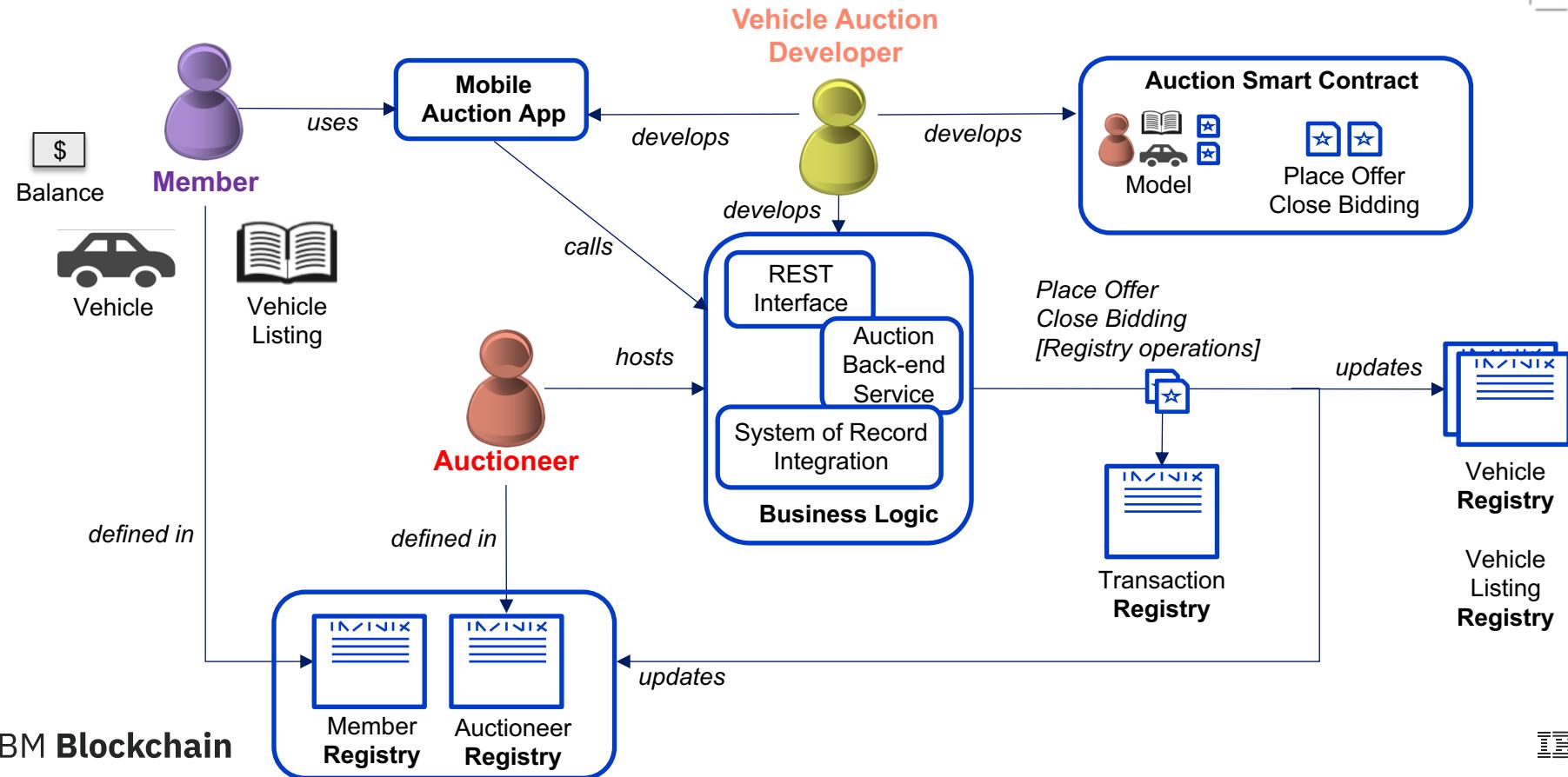
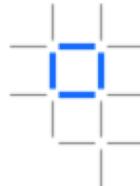


Effective Administration

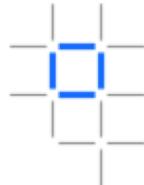
*Deploying to a blockchain
Interacting with systems of record*



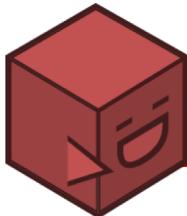
Key Concepts for a Vehicle Auction Developer



The Developer's three components



Smart Contracts



Business Logic



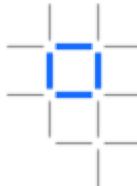
Presentation Logic

- 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

- **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

- 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

```
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
}
```



Member Auctioneer

```
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 {
```



Place Offer
Close Bidding

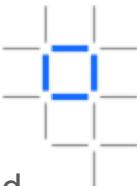
```
transaction Offer {
    o Double bidPrice
    --> VehicleListing listing
    --> Member member
}

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

Transaction Processors

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

function makeOffer(offer) {
 var listing = offer.listing;
 if (listing.state !== 'FOR_SALE') {



Access Control

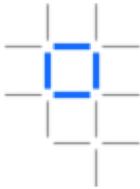
```
rule EverybodyCanReadEverything {
    description: "Allow all participants read access to all resources"
    participant: "org.acme.sample.SampleParticipant"
    operation: READ
    resource: "org.acme.sample.*"
    action: ALLOW
}
```

```
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

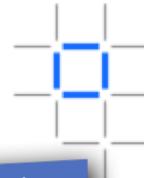
Smart Contract Development: Composer Playground



A screenshot of the Hyperledger Composer Playground web application. The left sidebar shows project files: README.md, models/sample.cto, lib/sample.js, and permissions.acl. A central panel displays the 'Basic Sample Business Network' definition, which includes a 'Hello World' description, definitions for Participant, Asset, Transaction, and Event, and a note about SampleAssets. Below this is a section for testing with instructions to create a SampleParticipant participant. The bottom navigation bar includes links for Legal, GitHub, Tutorial, Docs, Community, and playground v0.16.3.

- 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>

The screenshot shows the Hyperledger Composer playground interface. At the top, there are tabs for 'Define' and 'Test', and a user 'admin' with a 'Get local version' button. Below this is a table titled 'Default Historian Registry' with columns: ID, Time, Participant ID, and Transaction Type. Two rows are visible: one for an 'Offer' transaction and another for an 'ActivateCurrentIdentity' transaction. A modal window titled 'Transaction Data' is open for the first transaction, showing its details. The transaction ID is 'af9faaf...'. The 'Transaction' tab is selected, displaying the JSON content of the transaction record:

```
1  [
2    "$class": "org.hyperledger.composer.system.HistorianRecord",
3    "transactionId": "af9faaf...d15",
4    "transactionType": "Offer",
5    "transactionInvoked",
6    "resource:org.hyperledger.composer.system.Transaction#af9faaf...d15",
7    "participantInvoking",
8    "resource:org.hyperledger.composer.system.Participant#emma",
9    "identityUsed",
10   "resource:org.hyperledger.composer.system.Identity#8d0fdf5ef7c0062f67853ecf9b36544b2e2c36f0e9b9536166dc0f056a62a032",
11   "eventsEmitted": [],
12   "transactionTimestamp": "2017-08-11T16:15:00.161Z"
13 }
```

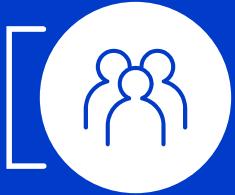


What is Hyperledger Composer?



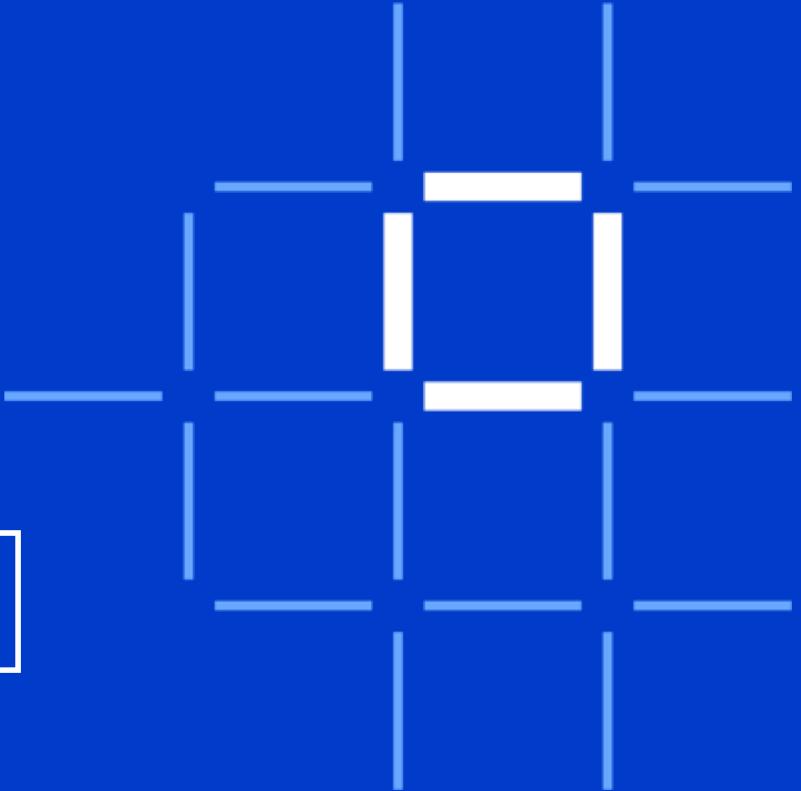
Application Development

*Writing the application
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
 - Includes transaction, app server, integration and presentation logic



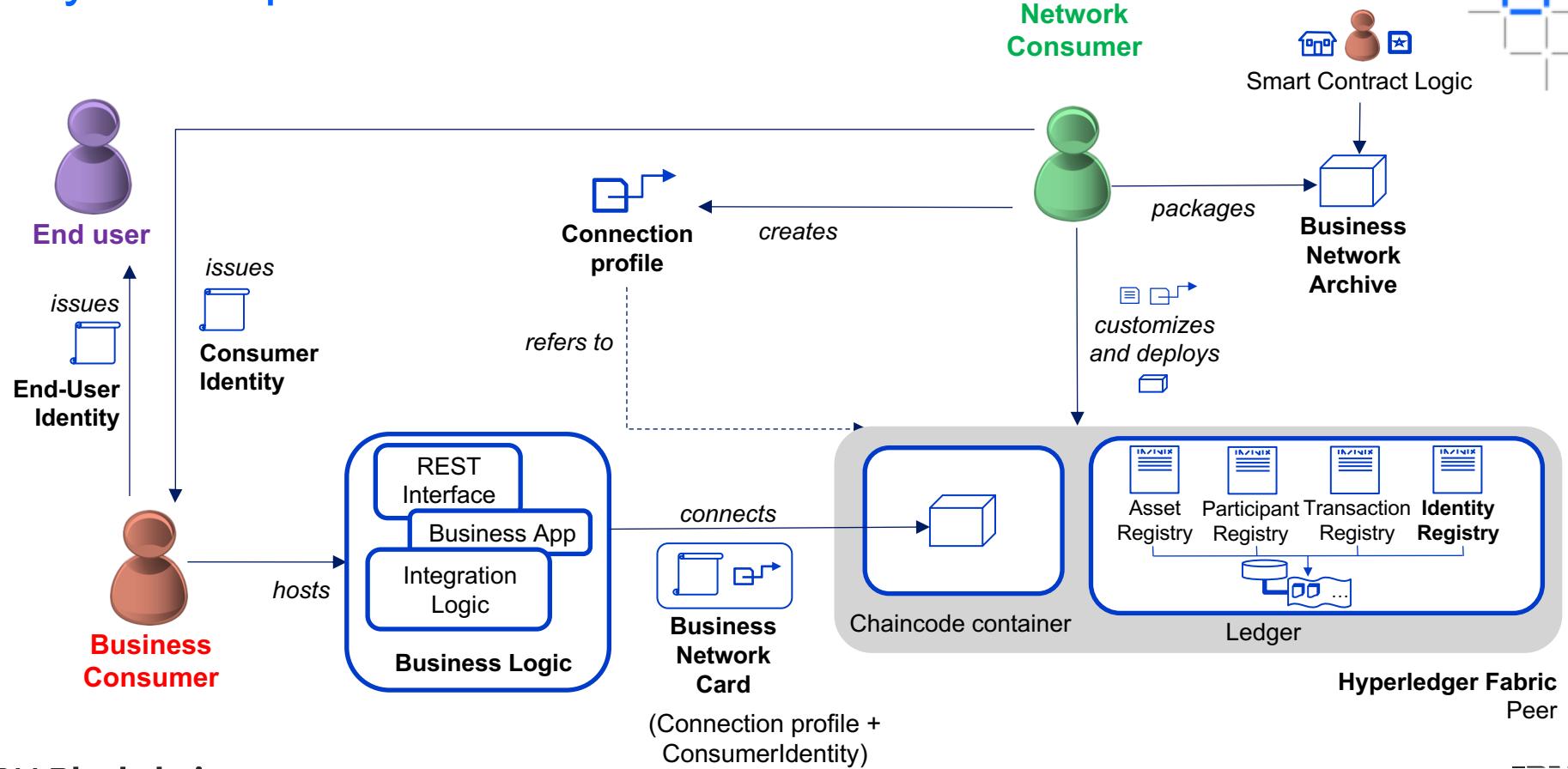
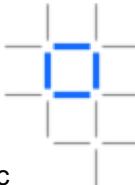
- Business Consumer
 - Hosts application and integration logic which invokes blockchain transactions

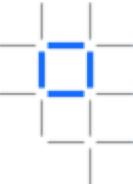


- End-user
 - Runs presentation logic e.g. on mobile device or dashboard

A single organization may play multiple roles!

Key Concepts for Administrators

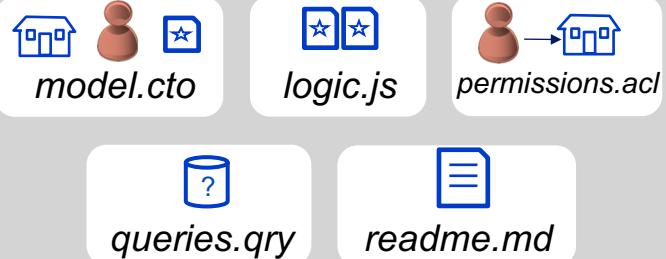




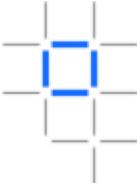
The Network Consumer packages resources into a BNA file

- 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

Business Network Archive



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



Connection Profiles to Hyperledger Fabric

Basic Configuration

Connection Profile Name	hfabric
Orderer(s)	Orderer URL grpc://orderer.example.com:7050
Channel	composerchannel
MSP ID	Org1MSP
Certificate Authority (CA)	URL http://ca.org1.example.com:7054 Name ca.org1.example.com
Peer(s)	Peer Request URL grpc://peer0.org1.example.com:7051 Peer Event URL grpc://peer0.org1.example.com:7053
Key Value Store Directory	/home/composer/.composer-credentials

Advanced

Use this profile Export Connection Profile

- 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 and Fabric with v1.1



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

Issue New Identity

Issue a new ID to a participant in your business network

ID Name* emma_id

Participant* resource:org.acme.vehicle.auction.Member#emma

Allow this ID to issue new IDs ()

Issuing an identity generates a one-time secret. You can choose to send this to somebody or use it yourself when it has been issued.

Identity Issued

Use it yourself

Just add the business network card to your wallet to start using the new identity yourself

Give the business network card a name
e.g. emma_id@carauction-network

Add to wallet

	E
CONNECTION PROFILE	hf1v1
USER ID	emma_id
BUSINESS NETWORK	carauction-network

Send it to someone else

For security, new identities can only be enrolled once

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
 - Similar to an ATM card

Hyperledger Composer Playground

My Business Networks

Connection: hlfv1

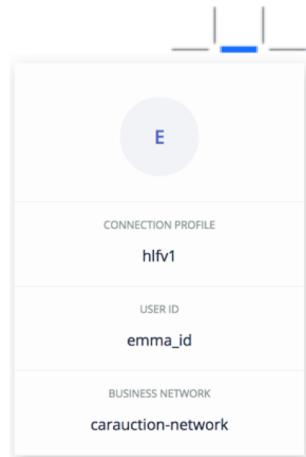
Import Business Network Card Create Business Network Card

User ID	Business Network
PeerAdmin	none
admin	carauction-network

PeerAdmin@hlfv1 myadmincard

USER ID BUSINESS NETWORK

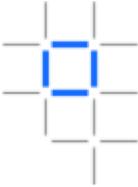
Connect now → Connect now →



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

angular-app

Auctioneer : A participant named Auctioneer

Show/Hide | List Operations |

CloseBidding : A transaction named CloseBidding

Show/Hide | List Operations |

Member : A participant named Member

Show/Hide | List Operations |

Offer : A transaction named Offer

Show/Hide | List Operations |

Vehicle : An asset named Vehicle

Show/Hide | List Operations |

GET /Vehicle

Find all instances of the model matched by filter fro

POST /Vehicle

Create a new instance of the model and persist it in

GET /Vehicle/{id}

Find a model instance by {{id}} fro

Request URL

http://0.0.0.0:3000/api/Vehicle

Response Body

```
[  
  {  
    "$class": "org.acme.vehicle.auction.Vehicle",  
    "vin": "VEH:1234",  
    "owner": "odowda@uk.ibm.com"  
  }  
]
```

IBM

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!

Hyperledger Rocket.Chat

You will need a [Linux Foundation ID](#), or alternatively you can log in with Facebook, GitHub, Google, or OpenStack.

[Let's chat](#)

Stack Overflow

Ask questions in Stack Overflow with the tag `#hyperledger-composer`.

[Ask now](#)

Contribute to the Project

GitHub

Check out the code, feel free to get involved.

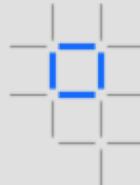
[GitHub](#)

Community Call

Join our weekly open community calls.

[Learn how](#)

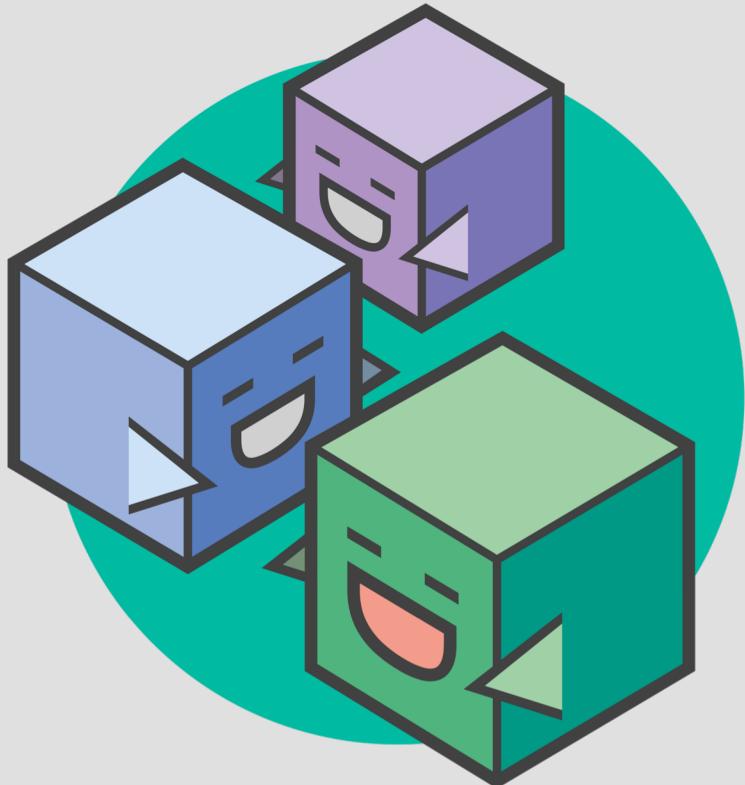
Get started with Hyperledger Composer



- 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

Austin Grice

austin.grice@ibm.com

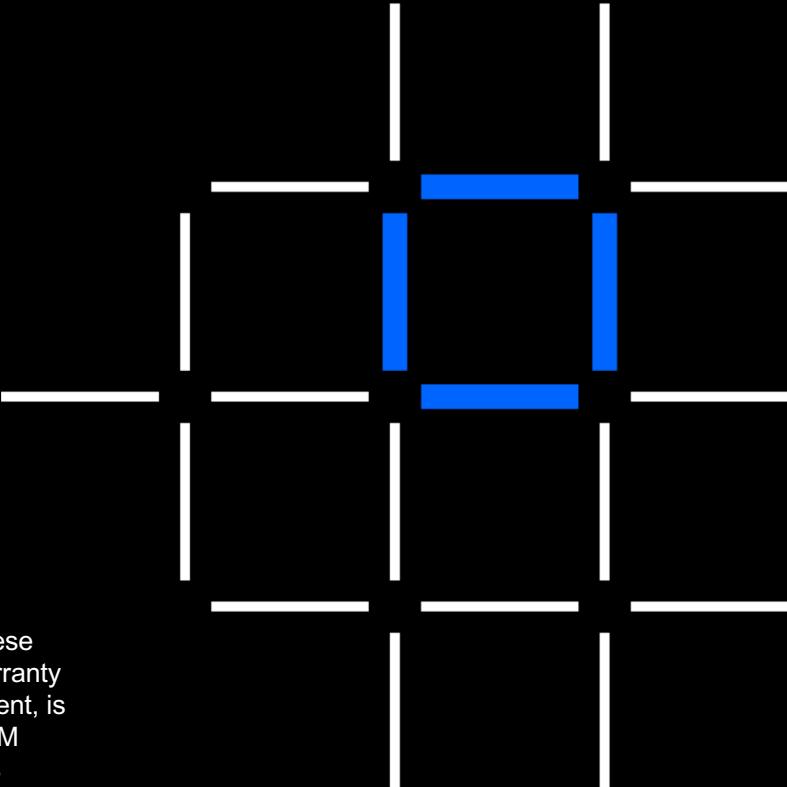
Blockchain Leader

IBM Blockchain

www.ibm.com/blockchain

developer.ibm.com/blockchain

www.hyperledger.org

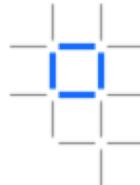


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Immunichain

Tracking of Immunization Records



Guardians	Medical Providers	Members	Children
<ul style="list-style-type: none">• Overseer of Children• Can assign medical providers• Can assign members• Can remove members and medical providers	<ul style="list-style-type: none">• Can administer immunization shots• Only have access to children that has been granted to them	<ul style="list-style-type: none">• Similar to organizations or schools• Can only read the children's record• Can't view other participants	<ul style="list-style-type: none">• The asset in this business network• Assigned to a guardian• Can be independent once over 18

<https://immunichain.zcloud.marist.edu/login/>

