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Module 4

Blockchain composed

Outline

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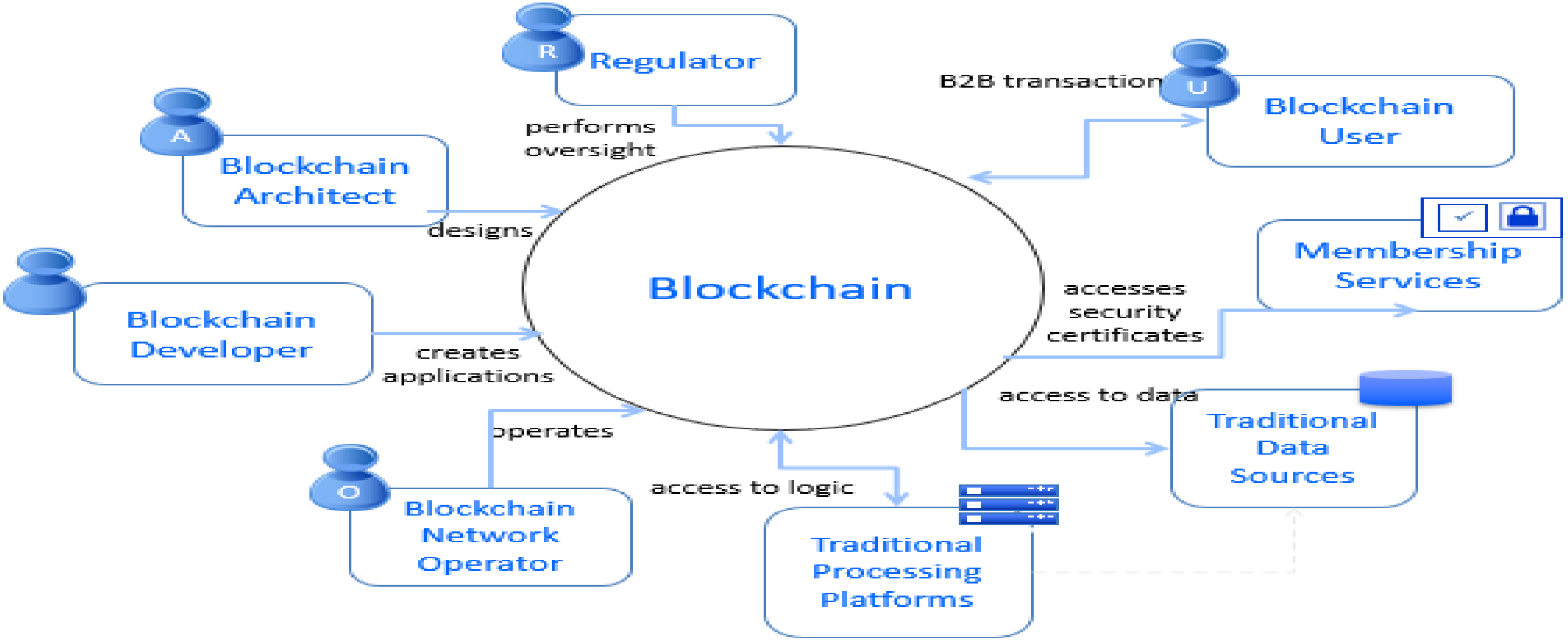
- What is Hyperledger Composer
- Components and Structure of Composer
- An example Business Network: Car Auction Market
- Extensive
- Familiar
- Open Tool Set

Actors in Blockchain



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- Blockchain Architect –
  Responsible for architecture and design of the blockchain. Blockchain Architect is the one who is going to design, how the blockchain solution is going to be built. He will figure out what is some information that needs to get stored, what are the transactions and the business logic that needs to be embedded onto the network, and so on.

- Blockchain Developer –
  The developer of applications and smart contracts that interact with the blockchain and are used by the blockchain users. The blockchain developer is the one who is going to take what has been an architect and then develop the actual code that will run on the blockchain network itself.

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- 3. Blockchain Network Operator –
  Manages and monitors the blockchain network. Each sub-work or the business in the network has a blockchain network operator. He also runs the blockchain network.
- 4. Traditional Processing Platforms –
  An existing computer system may be used by the blockchain to augment processing. The system may also need to initiate the request to the blockchain. Other systems send or get information that is required to build a blockchain solution.
- 5. Traditional Data Sources –
  An existing computer system may provide data to influence the behavior of the smart contract. They are also part of the overall solution to store external data.

Continue...

- 6. Membership Services –
  It manages different types of certificates, which are required to run a permission blockchain. Membership services provide the identity for users to come and transact on the blockchain. For example, if you open an account with the bank, they give you a username and password, a kind of login to access web services, Membership services is going to do more than that not only username and password but also give a digital certificate that will allow you to transact on the network.
- 7. Blockchain User –
  The business user, operating in a business network. User experiences the application of that blockchain solution. They are not aware of blockchain. Blockchain user is the one who is going to perform the business transactions on the blockchain, So, these users could belong to multiple organizations that are participating in that blockchain

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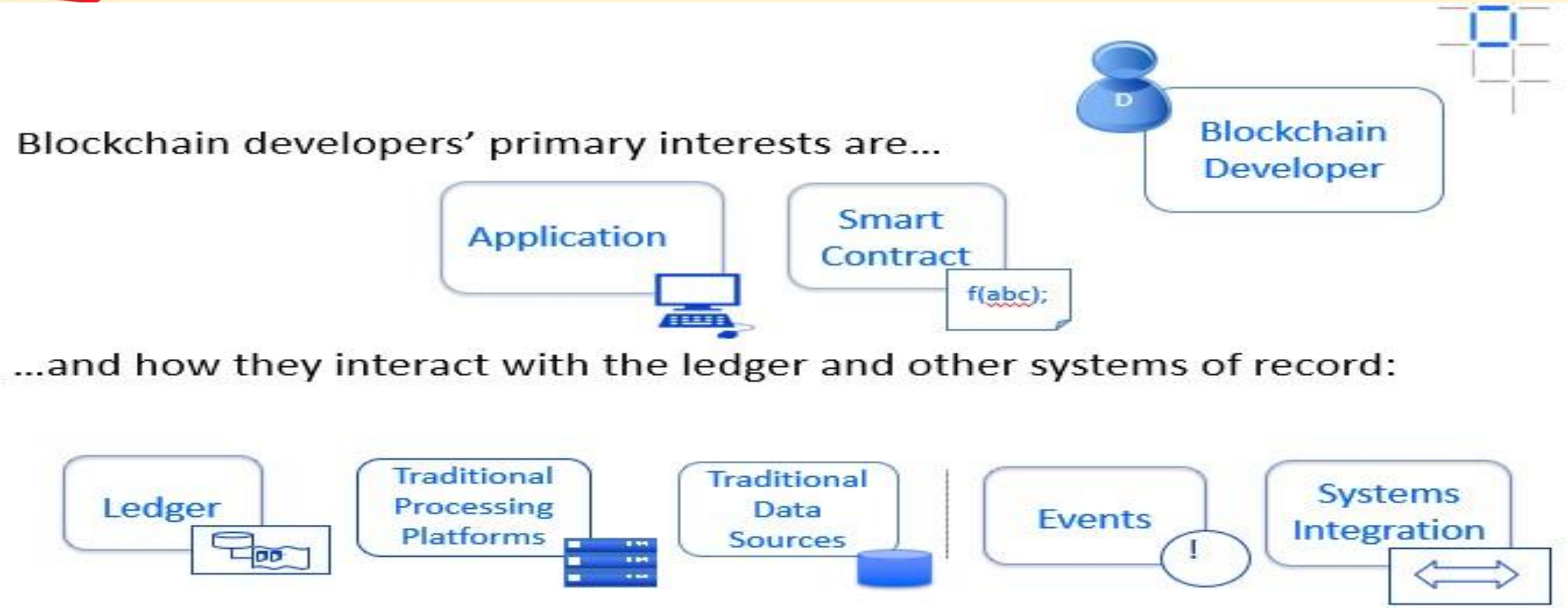
- 8. Blockchain Regulator –
  The overall authority is a business network. Specifically, regulators are required to read the ledger's content broadly. The Blockchain regulator is an optional one, they might have only, read-only access onto the network where they see the transactions being performed are legitimate or not, following policies or not, etc.

The Blockchain Developer



Components of Blockchain Solution

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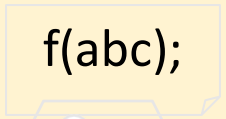
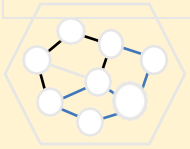
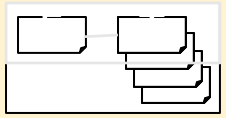
Ledger		List of transactions maintained by peers
Smart Contract		Software running on peer, updates the world state
Peer Network		Network which reaches consensus to add blocks
Membership		Authenticates and manages identities on network
Events		Emits notifications of operations on network
Systems Management		Enables us to create/monitor blockchain components
Wallet		Securely manages a user's credentials
Integration		

Hyperledger Composer

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- Hyperledger Composer is a set of collaboration tools for business owners and developers that make it easy to write chaincode (also known as smart contracts) for Hyperledger Fabric and Decentralized Applications (DApps).
- With Composer, you can quickly build Proof-of-Concept and deploy chaincode to the blockchain in a short amount of time.

- **Hyperledger Composer consists of the following toolsets:**

- A modeling language called CTO: A domain modeling language that defines a business model, concept, and function for a business network definition
- Playground: Rapid configuration, deployment, and testing of a business network
- Command-line interface (CLI) tools: The client command-line tool is used to integrate business network with Hyperledger Fabric

Hyperledger Composer

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- Hyperledger Composer is an extensive, open development toolset and framework to make developing blockchain applications easier.
- Instead of developing smart contracts from scratch, Composer provides a convenience layer and business-level abstractions to implement smart contracts on Fabric.
- Composer also makes it easier for you to connect to your business network from a web or mobile application

Hyperledger Composer

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- Hyperledger Composer is a set of collaboration tools for building blockchain business networks that make it simple and fast for business owners and developers to create smart contracts and blockchain applications to solve business problems

- Extensive
- Open development toolset and
- Framework to make developing Blockchain applications easier.

Hyperledger Composer

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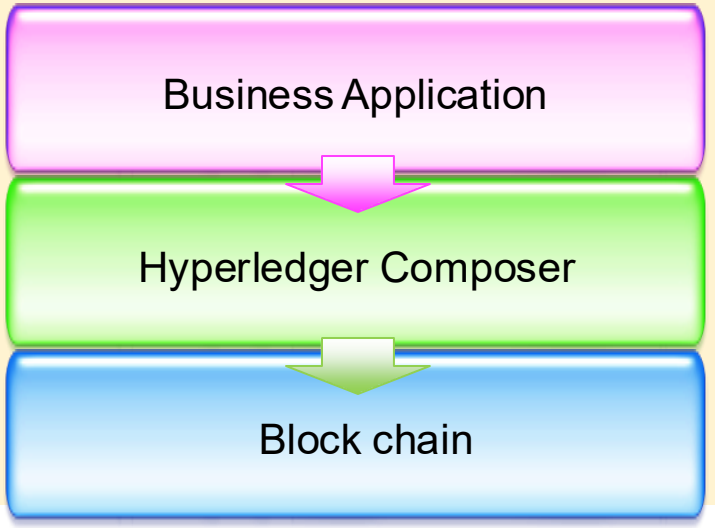
- A suite of high level application abstractions for business networks
- Emphasis on business-centric vocabulary for quick solution creation
- Reduce risk, and increase understanding and flexibility

- **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 REST APIs



Hyperledger Composer Architecture

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- Hyperledger Composer is an open framework device to make blockchain programs efficient to a large extent. It linked the blockchain application with the records of business systems.
- It allows the developers to create full-stack blockchain application solutions.
- It uses the Hyperledger Fabric architecture to enable the protocols and policies and to have verified transactions.
- The current business network can be easily monitored by Hyperledger Composer which can include the assets, services, property, etc.

Key Concepts in Hyperledger Composer

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- **Assets:** They are known as services and properties, they can constitute the buying and selling of a business model. Moreover, it is unique so that the user may define the properties.
- **Participants:** They are the members who are taking part in the business network. They only buy and sell the assets. They may have multiple identities and hence transactions can be done.
- **Identities:** It is a digital certificate or digital signature which is referred to as an identity of a participant. Every participant has different IDs.
- **Transactions:** It is a process in which exchanging of assets with the currency takes place. It can be done in the form of an auction and ownership will provide to the highest bidder.

Key Concepts in Hyperledger Composer

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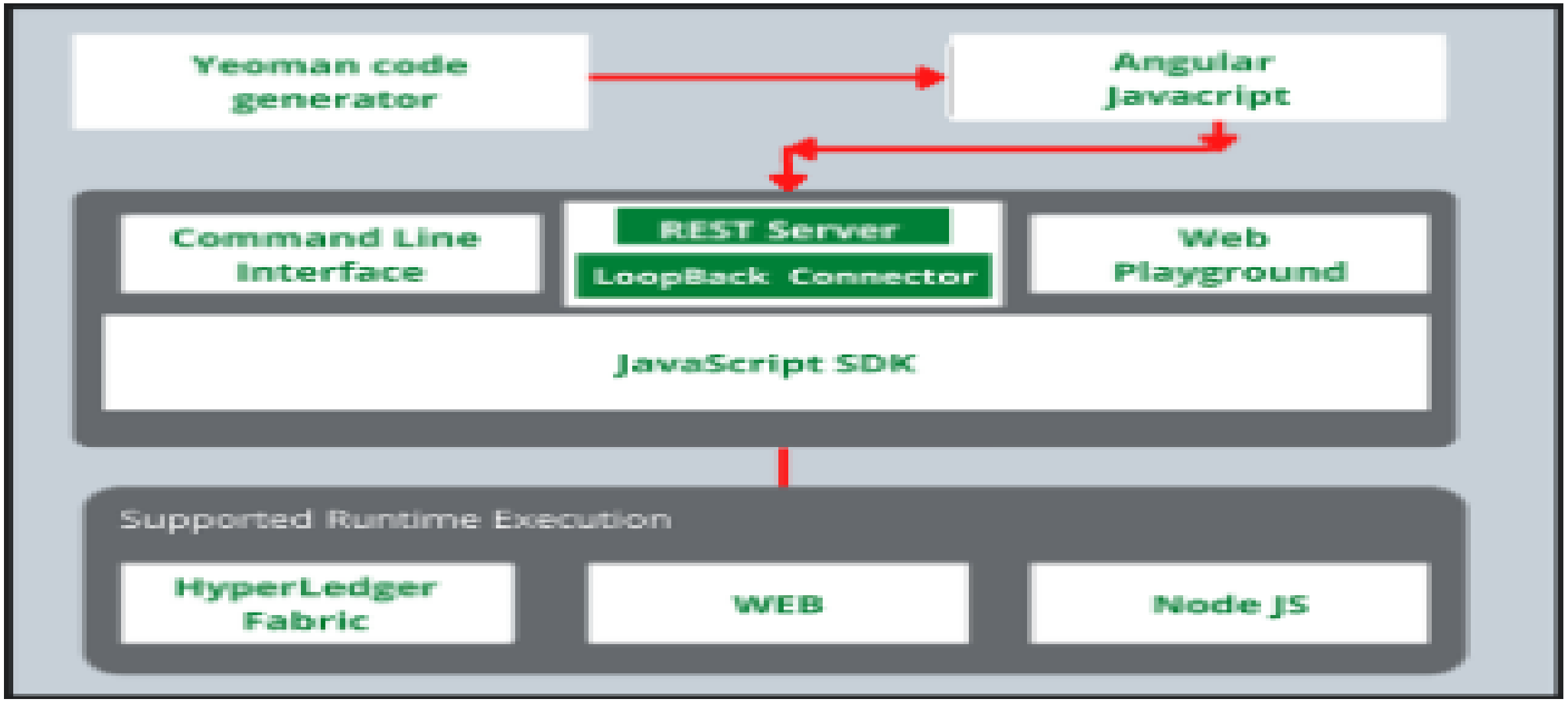
- **Queries:** They are the commands from which the business network can be accessed, these customizations are sent with the help of APIs.
- **Events:** Events are the indications to external systems to alert them about the ledger.
- **Access control:** The access controls are the set of policies and protocols on which the business network works.
- **Blockchain state storage:** It is a storage in which transactions of a business network are stored, and databases are consistent by the algorithms.
- **Connection profiles:** It is a JSON document that is related to the business network card. This is used to make business network cards so that they can be linked to the business network.
- **Business network cards:** It is the combination of metadata, connection profile, and identity.

Key Concepts in Hyperledger Composer

- Historian Registry: It is a report type registry in which it shows the completion of transactions under the historian records column.

Architecture of Hyperledger Composer



Component of Hyperledger Composer

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1. Yeoman code generator:

- This will help the user to create various new projects.
- It executes with the specific commands in CLI in the node.
- It includes testing, modification, and building process.

2. Javascript Software development toolkit and framework like Angular JS (JS SDK):

- JavaScript SDK contains Node JS APIs that help developers to create an application that can be linked to the business system networks.
- It can be divided into two parts: composer client and composer admin

Component of Hyperledger Composer

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3. Command Line Interface(CLI):

- It permits creators to control or execute business networks through instructions.
- Moreover, creators can easily communicate with the OS and PC hardware associated with the business network model.

4. REST web servers and APIs:

- Refer to as a state of transfer that is used to create a model of the business network.
- It calls APIs to declare the resources like configure.

5. LoopBack Connector:

- It helps in exchanging business data and transactions securely among the networks.
- It handles responses and requests from source protocols.

Component of Hyperledger Composer

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6. Web User Interface:

- It helps in testing and managing the business data and managing the supported runtime execution i.e, Hyperledger Fabric.
- It also helps in interaction with the remotely running software with the specific web server.

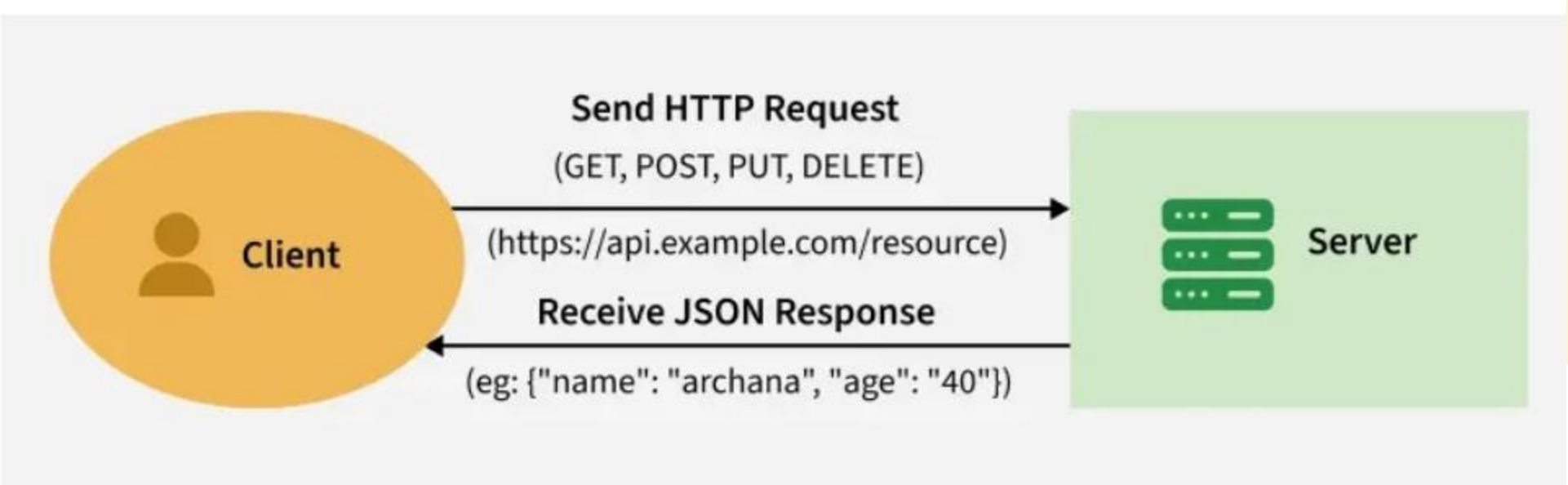
7. Execution Runtimes:

- It consists of three parts: Hyperledger Fabric, Web, and Node.js which perform different functions such as state will be stored in browser local storage and particular ledger.

REST API Introduction

- REST API stands for REpresentational State Transfer API. It is a type of API (Application Programming Interface) that allows communication between different systems over the internet. REST APIs work by sending requests and receiving responses, typically in JSON format, between the client and server.

- REST APIs use HTTP methods (such as GET, POST, PUT, DELETE) to define actions that can be performed on resources. These methods align with CRUD (Create, Read, Update, Delete) operations, which are used to manipulate resources over the web.



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- A request is sent from the client to the server via a web URL, using one of the HTTP methods. The server then responds with the requested resource, which could be HTML, XML, Image, or JSON, with JSON being the most commonly used format for modern web services.

- REST is an architectural design style for APIs, while HTTP is the communication protocol used for data transfer over the web. REST APIs use HTTP methods to interact with resources, but they are not the same thing. REST defines how the APIs should behave, while HTTP defines the rules for communication over the web. They commonly work together, but they serve different purposes.

Developing With Hyperledger Composer

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- Hyperledger Composer provides multiple tools to facilitate the development of business networks. The tools permit both online and local development.
- The Hyperledger Composer Playground provides a user interface for the configuration, deployment, and manual testing of a business network.
- Advanced Playground features permit users to manage the security of the business network, invite participants to business networks, and connect to multiple blockchain business networks.
- Hyperledger Composer Playground is not intended to facilitate source code version control or the development of automated testing suites for use within build automation.
- For these requirements, you can use various version control tools and code editors, which have tools to provide syntax highlighting and scenario-based testing.

Developing Mainly three component in composer

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Business Service Provider develops three components

Smart Contracts

- Implements the logic deployed to the blockchain
  - **Models** describe assets, participants & transactions – expressive modeling language includes relationships and validation rules
  - **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 Application 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

Toolset in composer

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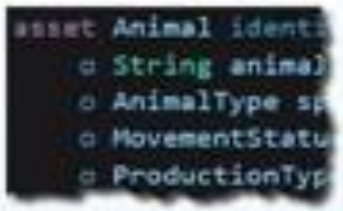
Extensive, Familiar, Open Development Toolset



Data modelling

JavaScript business logic

Web playground

Client libraries

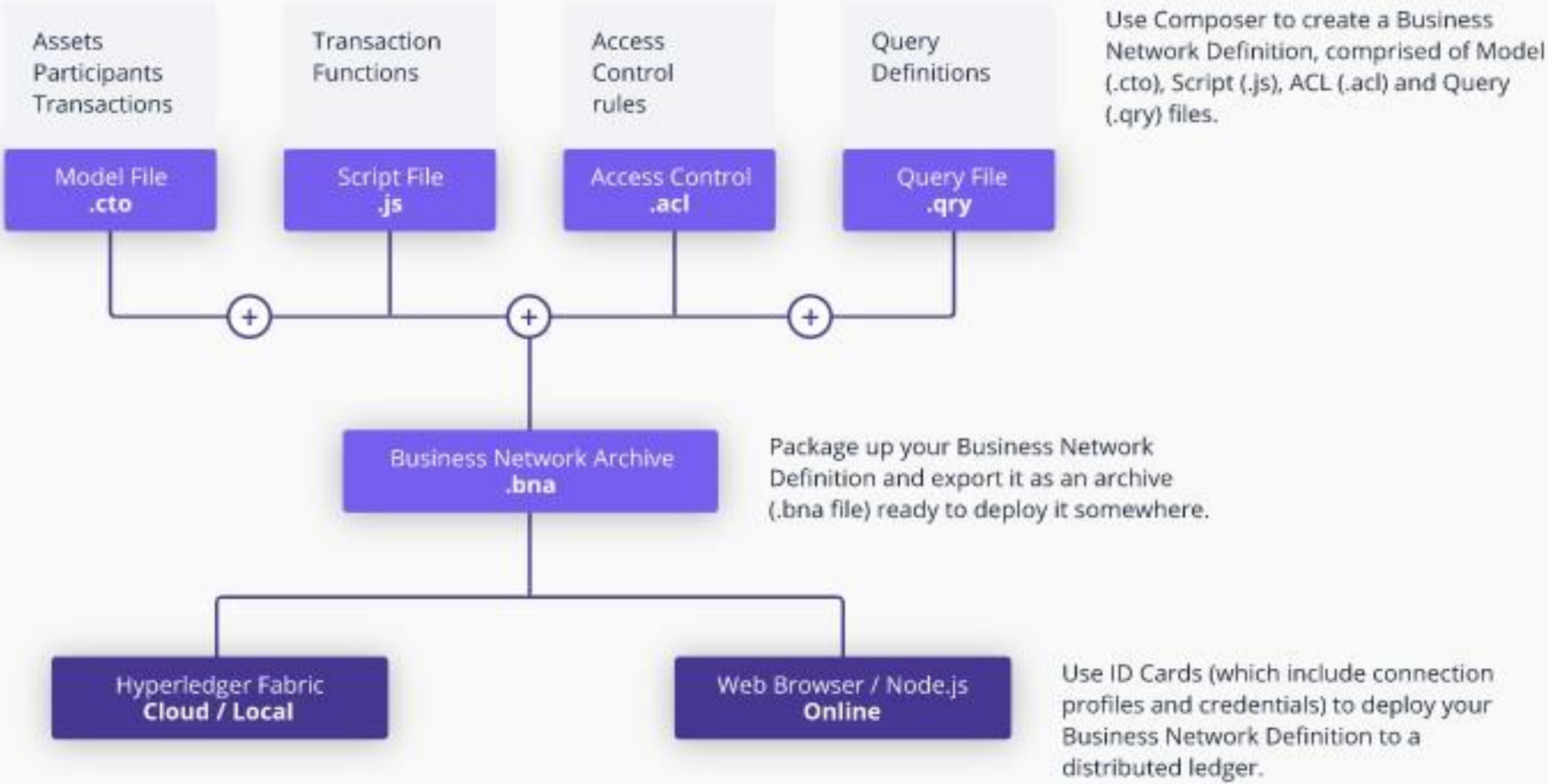
Editor support

CLI utilities

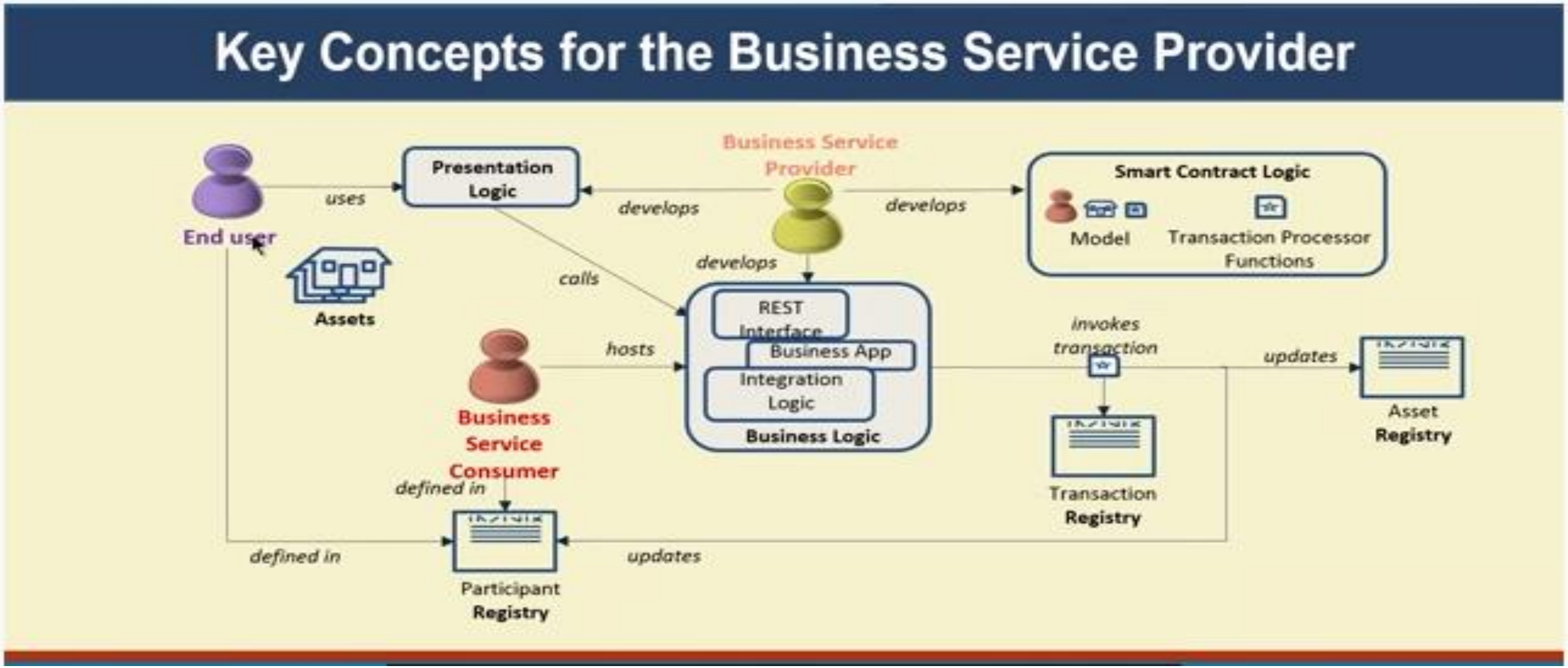
Code generation

Existing systems and data

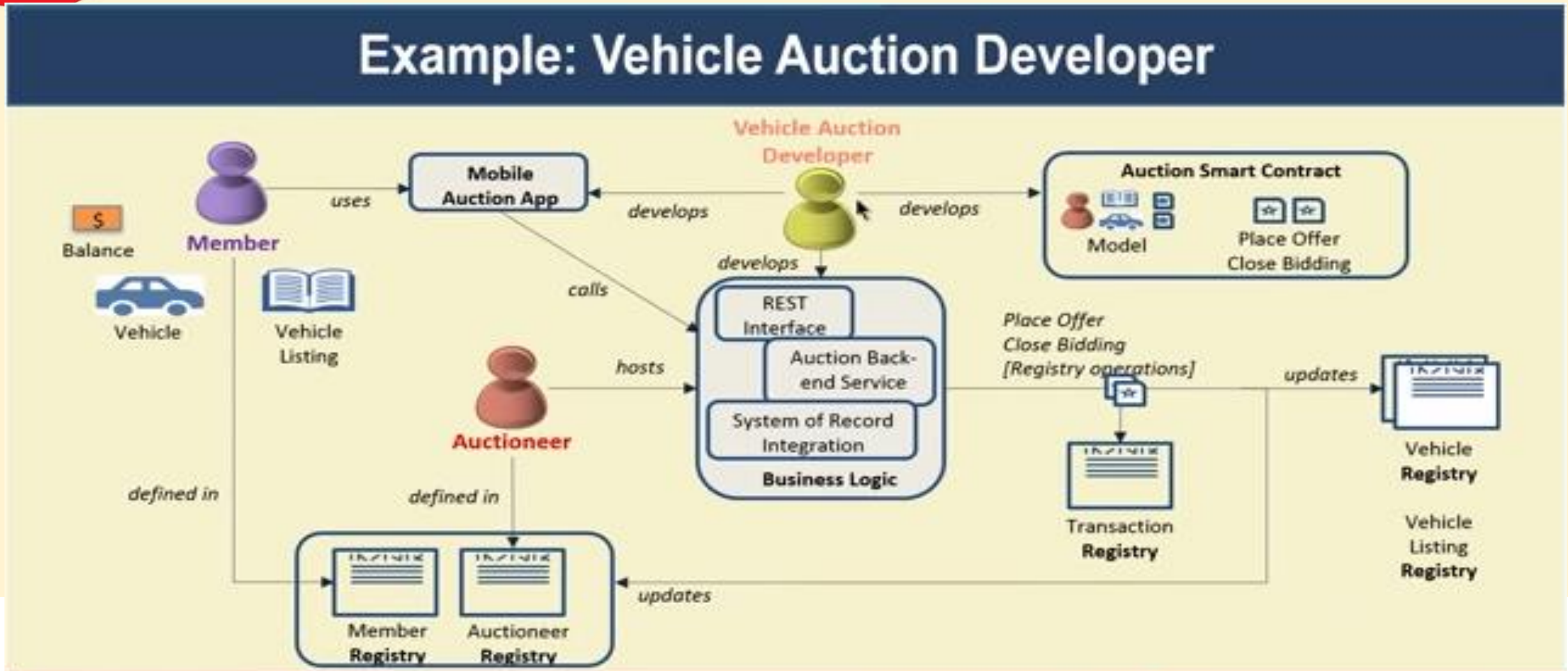
Pause (k)


Assets
Participants
Transactions
Transaction
Functions
Access
Control
rules
Query
Definitions
Use Composer to create a Business Network Definition, comprised of Model (.cto), Script (.js), ACL (.acl) and Query (.qry) files.
Model File
.cto
Script File
.js
Access Control
.acl
Query File
.qry
Business Network Archive
.bna
Package up your Business Network Definition and export it as an archive (.bna file) ready to deploy it somewhere.
Hyperledger Fabric
Cloud / Local
Web Browser / Node.js
Online
Use ID Cards (which include connection profiles and credentials) to deploy your Business Network Definition to a distributed ledger.

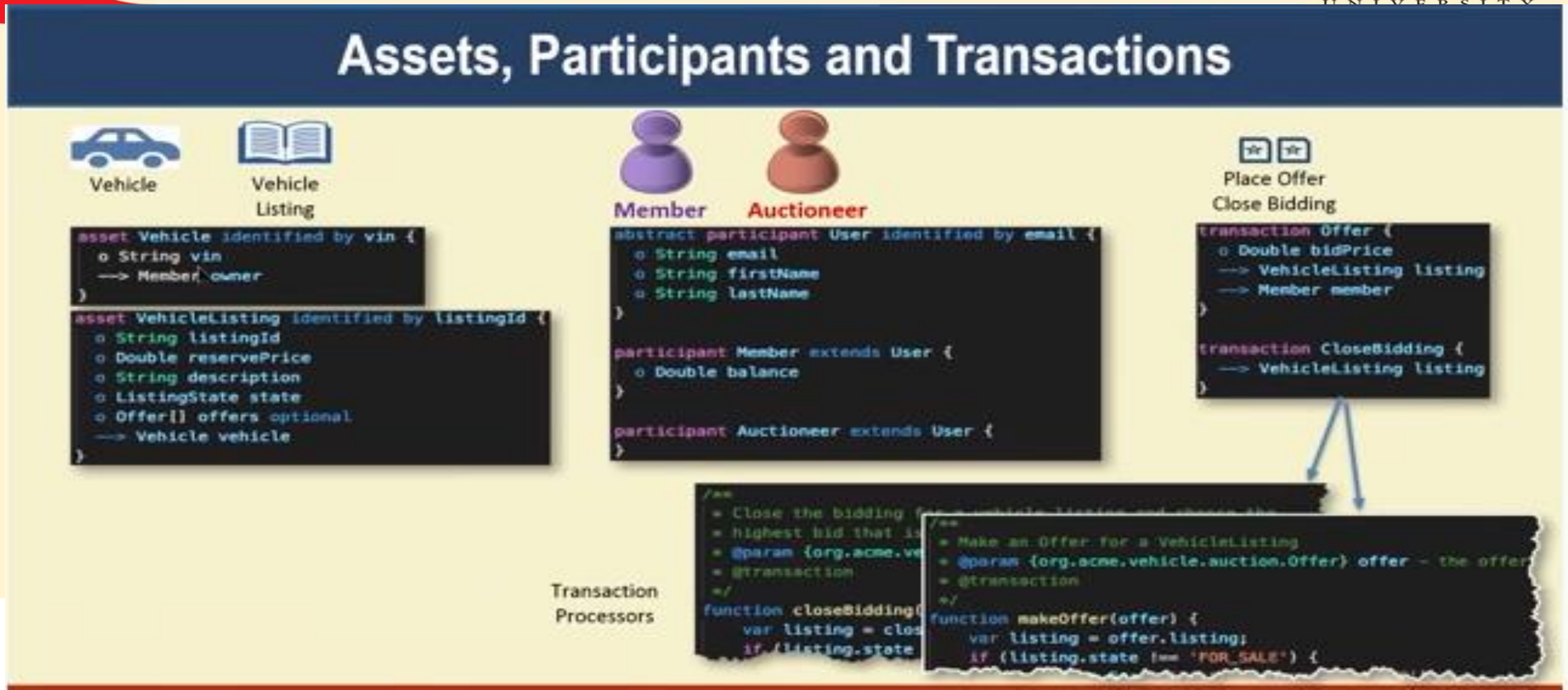
Concept of composer



Example


Example: Vehicle Auction Developer
Vehicle Auction Developer
Mobile Auction App
uses
develops
develops
Auction Smart Contract
Model
Place Offer
Close Bidding
Member
Balance
Vehicle
Vehicle Listing
calls
develops
REST Interface
Auction Back-end Service
System of Record Integration
Business Logic
hosts
Auctioneer
Place Offer
Close Bidding
[Registry operations]
updates
Vehicle Registry
Transaction Registry
Vehicle Listing Registry
defined in
defined in
updates
Member Registry
Auctioneer Registry

Defining process



Hyperledger Fabric

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- Hyperledger Fabric is intended as a foundation for developing applications or solutions with a modular architecture. Hyperledger Fabric allows components, such as consensus and membership services, to be plug-and-play. Its modular and versatile design satisfies a broad range of industry use cases. It offers a unique approach to consensus that enables performance at scale while preserving privacy.

Hyperledger – Case Study - Honeywell

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- Honeywell Aerospace creates online parts marketplace with Hyperledger Fabric.
- Model the marketplace on popular e-commerce sites
- Use blockchain to overcome the trust barrier
- Choose an effective blockchain framework
- Set high standards that encourage quick adoption
- Provide a stream of new benefits

History of Company

Company

- Founded in 1914
- Now a global provider of avionics, engines, systems, and service
- Products and services touch virtually every aircraft in the world and in space
- 2018 sales of $12.9 billion

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Goals

- To create an Amazon-type marketplace for used aircraft parts
- To cut purchasing time from days or weeks down to seconds
- To connect each physical part to its digital pedigree

Approach

- Model the marketplace on popular e-commerce sites
- Use blockchain to overcome the trust barrier
- Choose an effective blockchain framework
- Set high standards that encourage quick adoption
- Provide a stream of new benefits

Results

- $4 million in sales in less than a year
- More than 50 vendors with storefronts in the new marketplace
- Purchase time reduced from days to minutes
- Future boost to anti-counterfeit measures

Application with Blockchain

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To help shift the industry into modern times, Honeywell Aerospace set up a modern-looking and secure B2B marketplace for used aircraft parts called GoDirect Trade™.

Using blockchain to overcome the trust barrier

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- Since aviation is a heavily regulated industry, sales require certification from the U.S. Federal Aviation Administration and other agencies. Each part must be documented with a complete history of its ownership, use, and repairs.

- A commercial aircraft can be in service for up to 30 years with five or six owners. And airplanes aren't getting any simpler. If you count every rivet, the world's largest passenger jet, the Airbus A380, has about 4 million pieces.

- Needless to say, tracking all the information required on all those parts is a challenging, error-prone process. And any uncertified or counterfeit part that snuck into the supply chain could have dire consequences.

- “Parts sellers have tried platforms such as Amazon in the past,” says Butters. “But their efforts were unsuccessful because of the nuances and safety regulations involved in the aerospace market.”

- For one thing, Amazon couldn’t handle the technical documentation required for every part. For another, many buyers prefer to pay with purchase orders, not credit cards.

Benefits of Blockchain integration

- A decentralized network of computers maintaining an immutable ledger enables people with no particular trust in one another to buy and sell with peace of mind.
- “The encrypted digital trail cuts the need for paperwork and makes it quick and easy to check the certification and origin of a part,” says Samuel Engel, senior vice president and head of the aviation group at consulting firm ICF International Inc. Among the services ICF provides is to certify aircraft parts for clients.
- “A blockchain-based marketplace removes uncertainty from the transaction,” he says.
- Thanks to the blockchain records, buyers can now view vital data on many parts, such as:
- The entire lifecycle of a part
- The number of hours it was in service
- Any and all repairs made and by who, when and where
- All previous owners of the part

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- To build their marketplace, Honeywell experimented with Ethereum. But in the end they chose Hyperledger Fabric for their blockchain platform.
- Honeywell Aerospace's Chief Digital and Information Officer Sathish Muthukrishnan was previously with American Express, a founding member of the Hyperledger community. AMEX has used Hyperledger for several projects, including a more flexible members rewards system.
- For several years, Muthukrishnan has watched Hyperledger Fabric evolve. He appreciated the pace of its innovation and the quality of its code, much of it contributed by IBM.
- Among the critical factors Honeywell needed were low latency, high throughput, and fast send rates. Hyperledger Fabric provided all that, along with privacy controls such as channels that give a granular ability to manage data.

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- Muthukrishnan appreciates the support from the Hyperledger open-source community, where many members are grappling with supply-chain issues similar to those at Honeywell Aerospace.
- That said, he emphasizes that GoDirect Trade is platform-agnostic. If another blockchain framework appears in the future that can handle the job better, Honeywell is not locked into Hyperledger.
- With Hyperledger Fabric as the blockchain foundation, Honeywell developed a middleware layer on top of it. And the marketplace apps are designed to work with major other blockchains such as Ethereum or R3's Corda.
- "You can't force everyone else to adopt your particular solution," says Muthukrishnan.
- The network currently includes five validating nodes running Hyperledger Fabric version 1.4 deployed on Honeywell enterprise cloud and other commercial clouds. To preserve data security, the system uses channels and private data collections.

GoDirect Trade Storefronts

Listing Event

Part history event

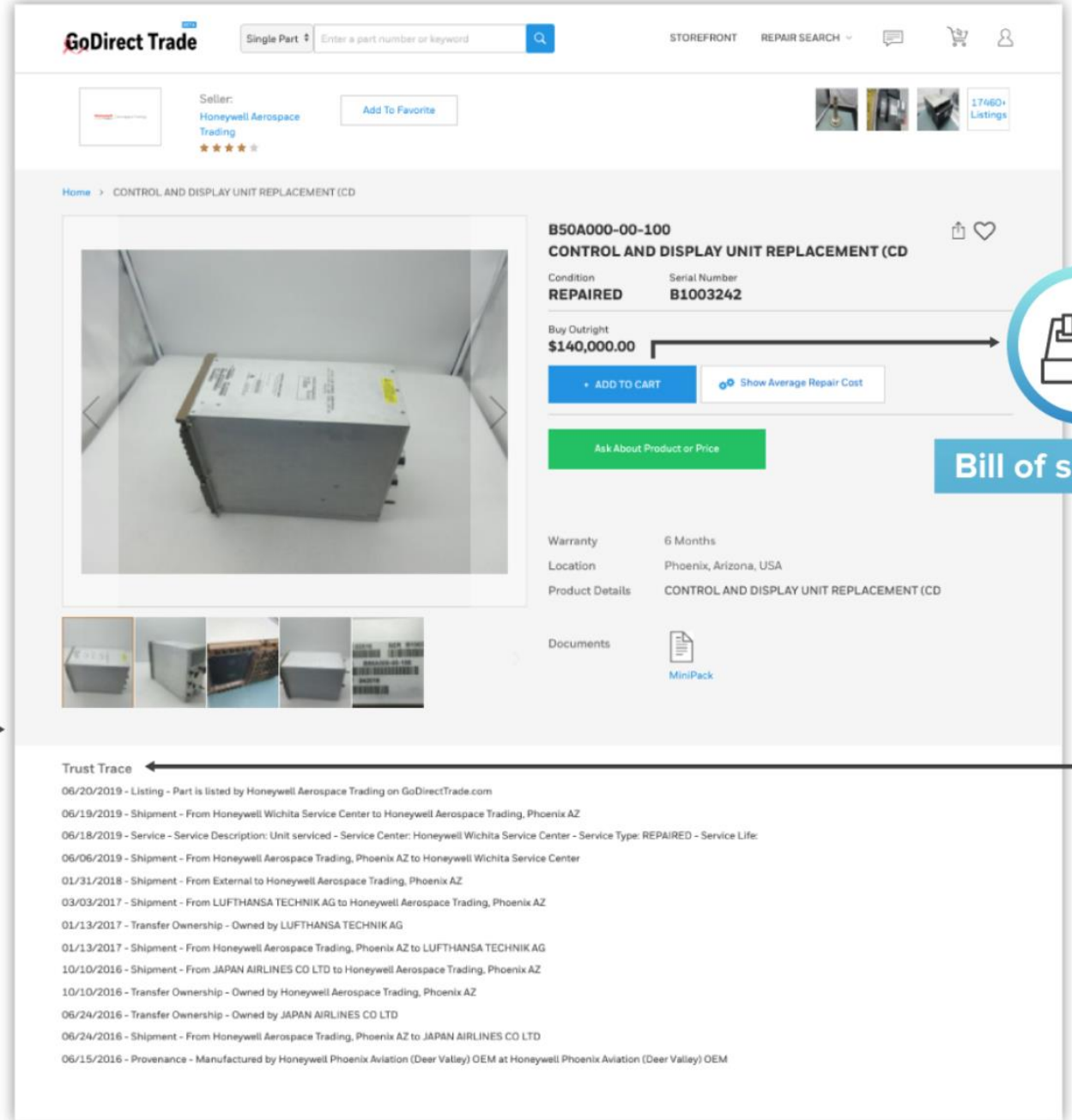
Repair and overhaul event

Honeywell
AEROSPACE

OEM birth event

Dismantlement event

Typical events recorded on Hyperledger blockchain



Bill of sale event

Typical Screen in GoDirect Trade

Hyperledger Sawtooth

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- Hyperledger sawtooth is an open-source enterprise blockchain-as-a-service platform that can run customized smart contracts without needing to know the underlying design of the core system.

- It supports a variety of consensus algorithms including PBFT and PoET.
- Its user-friendly design gives a flawless performance for enterprise usage.
- It supports separate permissioning i.e. there is no centralized service that can reveal confidential information.
- Sawtooth also has a modular design that allows for pluggable consensus algorithms and supports both permissioned and permissionless networks.

Working of Sawtooth

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- Sawtooth's core component is a distributed ledger that records a log of all transactions and smart contract execution.
- The ledger is replicated across all nodes in the network, and transactions are processed in parallel to increase performance.
- Sawtooth also includes a smart contract engine called "Sawtooth Lake" which allows for easy deployment and execution of smart contracts.
- The platform also provides a RESTful API for interacting with the ledger and submitting transactions.
- Sawtooth is designed to be highly scalable and can support networks with thousands of nodes and millions of transactions per second.
- Hyperledger Sawtooth makes it simpler to develop apps while retaining system security by separating the core ledger system from the environment pertinent to each application.

Continue...

- Application developers can describe the business rules appropriate for their application without being familiar with the core system's underlying architecture.

- This design enables developers to build applications that can be hosted, managed and used outside of the core blockchain network in their favourite programming language.

Features of Hyperledger Sawtooth

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- Separation Between the Application Level and the Core System
- Sawtooth Permissioning Features in Private Networks
- Parallel Transaction Execution
- Ethereum Contract Compatibility with Seth
- Dynamic Consensus
- Sample Transaction Families

Elements of Sawtooth Architecture

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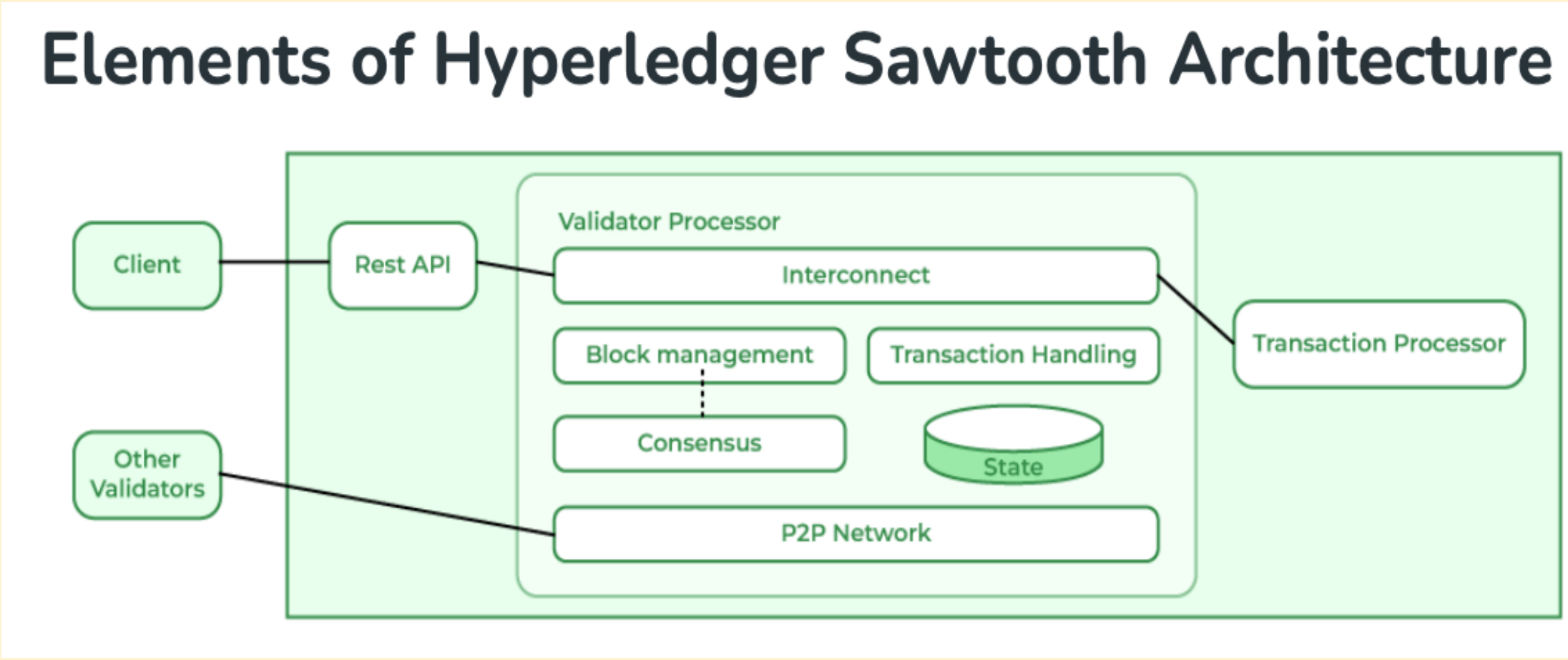

	HYPERLEDGER SAWTOOTH	HYPERLEDGER FABRIC	
Permission Level	Permissioned and Permissionless	Permissioned	
BFT Support	Yes, supports Byzantine Fault Tolerance	No, only supports Crash Fault Tolerance	
Transaction Processing	Validators	Endorsing Peers and Ordering Services	
Consensus Algorithm	Proof of Elapsed Time, Practical Byzantine Fault Tolerance, Raft, Devmode	Kafka, Raft, Solo	
Transaction Speed	>1000 TPS	>2000 TPS	
EVM Support	Yes (through Seth)	Yes	
Smart Contract Technology	Transaction Families	Chaincode	
State Storage	Central lmdb database	CouchDB or leveldb	
Smart Contract Language	Rust, JavaScript, Go, or Python; Supports Solidity using Seth	Go, Java, JavaScript, Solidity	
Smart Contract Type	On-chain and Installed	Installed