# Blockchain Enabled Solutions


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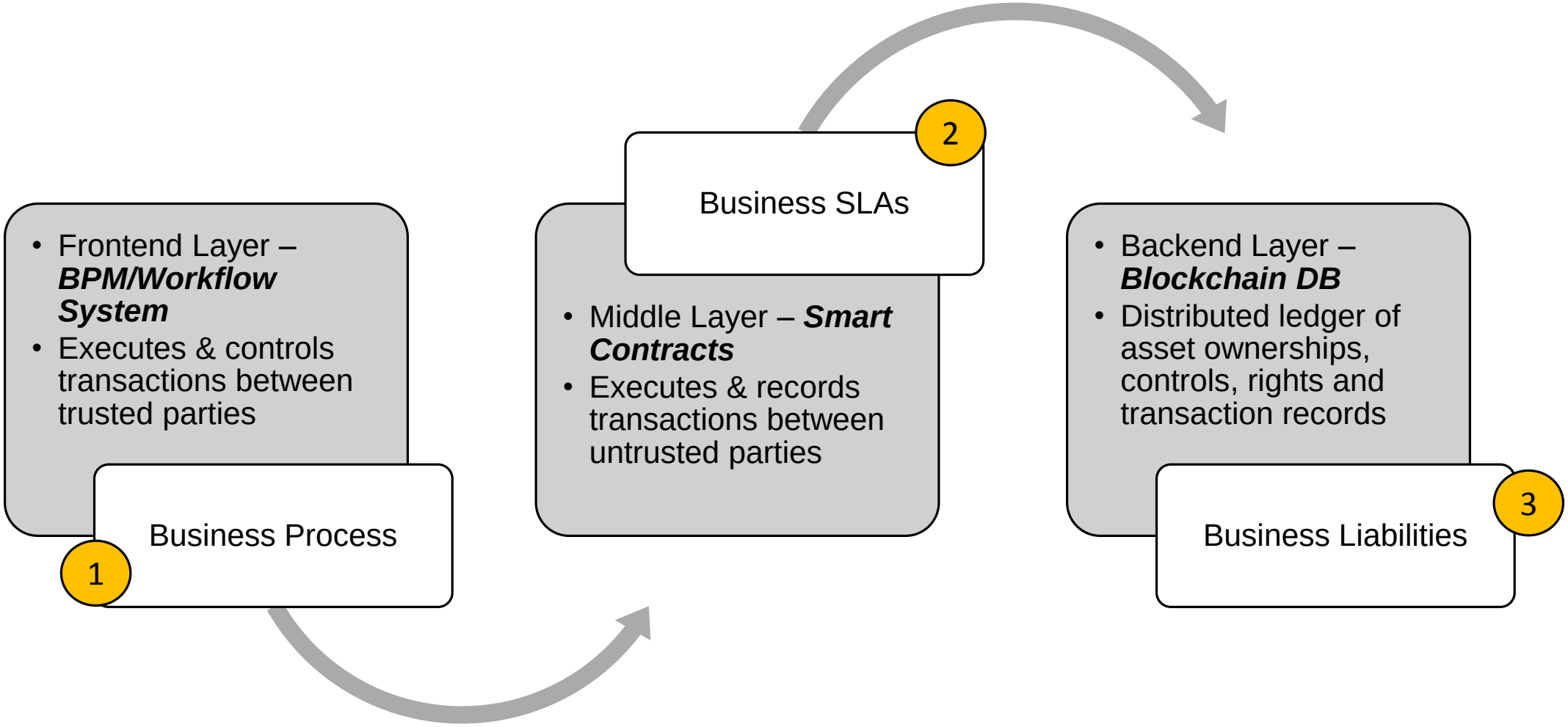
# Adopting Blockchain as a BPM Strategy





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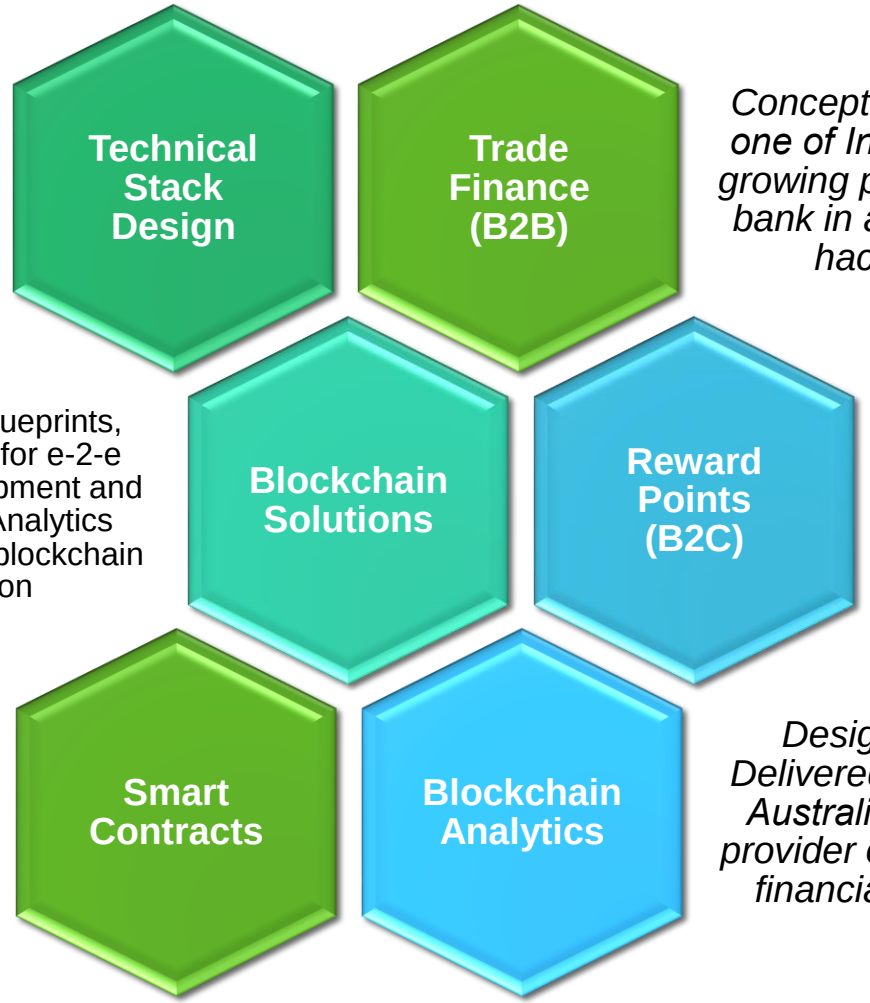
# Key Blockchain Engagements

*Developing a full technical stack on top of a blockchain platform for a startup in Houston, US*




*Concept shared with one of India's fastest growing private sector bank in a sponsored hackathon*

Designing Blueprints, Architecture for e-2-e stack, Development and supporting Analytics Programs for blockchain adoption

*Designed a POC for India's largest private sector bank*

*Worked on Smart LSTK Contracts for a major Oil and Gas Operator in India*

*Designed and Delivered a POC for Australia's leading provider of integrated financial services*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# LSTK (Lump Sum Turn Key) Contracts in Oil & Gas/EPC Industry

## Blockchain based Smart LSTK Contracts


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# Scope of Work

1) Visibility of the activities pertaining to various sub vendors, should be enabled through blockchain based smart contracts
2) The activities of selecting sub vendor, awarding the contract, fixing the sub vendor milestones, commercial activities like placing of PO, opening of LC, its acceptance by sub vendors etc. needs to be visible
3) Activities of the main contractor, such as, taking insurance, approvals from various statutory agencies, progress of the Project, Document/Material control indices are desired to be made tracked through the blockchain based smart contracts
4) Enable smooth finalisation of non-performance deductions, if any, without any contention
5) Integration/Interfacing with existing PMIS/CMS like SAP Project Module, SAP C - folders, Primavera, MS Project to pull out the data and use in blockchain based smart contracts


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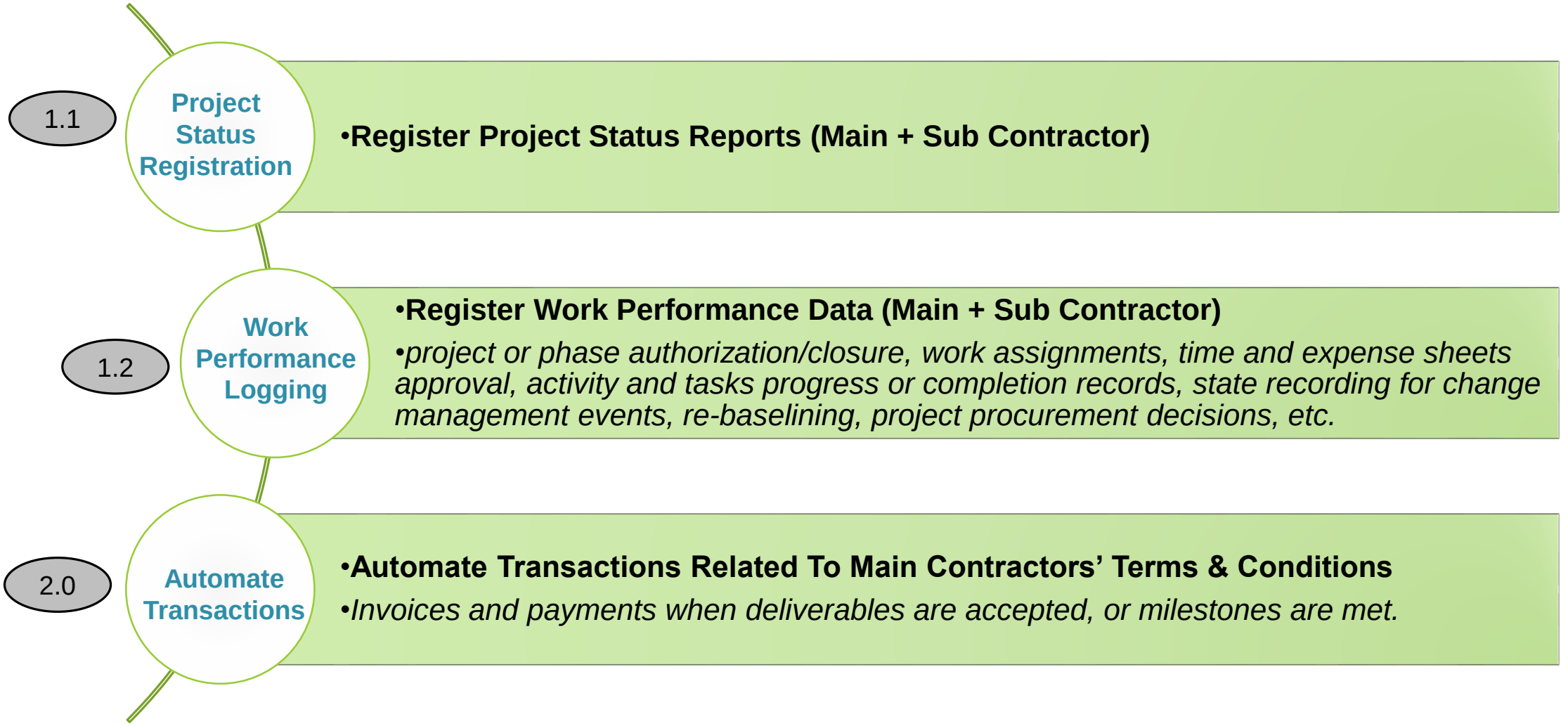
# Smart Contracts in Project Management





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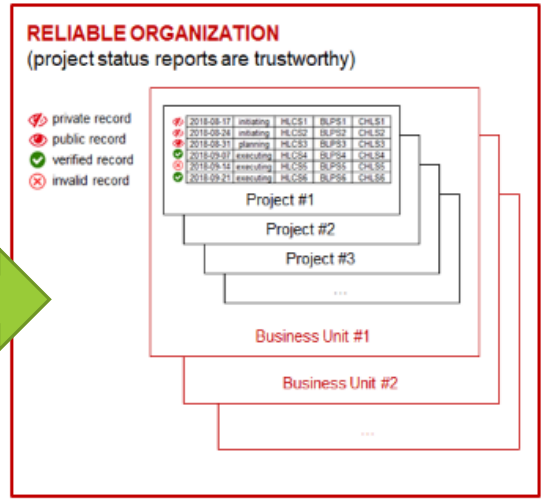
# Blockchain enabled Contract/Project Management

***4 states are possible for any specific project record***


- ✓ **Private record**: Project status has not been stored on Blockchain.
- ✓ **Public record**: Project manager has stored project status on Blockchain.
- ✓ **Verified record**: At least one stakeholder has checked that the stored project status matches the information in the PMIS tool.
- ✓ **Invalidated record**: At least one stakeholder has checked that the stored project status does not match the information in the PMIS tool.

**PROJECT STATUS PUBLIC RECORD**

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | project review date | project stage | project's health check state (HLCS) | baseline performance state (BLPS) | change log state (CHLS) |
| | 2018-08-17 | initiating | HLCS1 | BLPS1 | CHLS1 |
| | 2018-08-24 | initiating | HLCS2 | BLPS2 | CHLS2 |
| | 2018-08-31 | planning | HLCS3 | BLPS3 | CHLS3 |
| | 2018-09-07 | executing | HLCS4 | BLPS4 | CHLS4 |
| | 2018-09-14 | executing | HLCS5 | BLPS5 | CHLS5 |
| | 2018-09-21 | executing | HLCS6 | BLPS6 | CHLS6 |





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# Blockchain enabled Contract/Project Management

*Building Blocks – PMIS/CMS Data, API Enablement, Smart Contracts, Blockchain Transactions, Audits, Visualization, etc.*

| Document Number | Document Description | Category | Float Enquiry (1 %) | Receipt of Offers (2 %) | Final TBE (4 %) | Place P.O/LOI (5 %) | Start Manuf. (5.1 %) | PS 1st Stage Approval (10 %) | PS 2nd Stage Approval (15 %) | Final Insp. Complete (45 %) | Material Disp(1st Lot) (50 %) | Del. at Site (1st Lot) (55 %) | Material Disp(2nd Lot) (60 %) | Del. at Site (2nd Lot) (75 %) | Material Disp(Last Lot (80 %) | Del. at Site (Last Lot) (95 %) | TPI Release Note (100 %) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7234-17-56711 | HVAC/AIR COOLED CONDENSING UNIT | ID | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1010 | PROCAR1010 | PROCAR1010 | PROCAR1020 | PROCAR1020 | PROCAR1030 | PROCAR1030 | PROCAR1040 | PROCAR1040 | PROCAR1050 |
| 7234-17-56711 | HVAC/AIR COOLED CONDENSING UNIT | P | 15/05/18 | 22/05/18 | 11/06/18 | 18/06/18 | 19/06/18 | 12/09/18 | 03/10/18 | 10/10/18 | 17/10/18 | 30/10/18 | 01/11/18 | 14/11/18 | 26/11/18 | 09/12/18 | 07/02/19 |
| 7234-17-56711 | HVAC/AIR COOLED CONDENSING UNIT | L | 12/06/18 | 19/06/18 | 09/07/18 | 16/07/18 | 17/07/18 | 10/10/18 | 08/11/18 | 14/11/18 | 22/11/18 | 05/12/18 | 10/12/18 | 23/12/18 | 24/12/18 | 06/01/19 | 31/03/19 |


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https://bridge.buddyweb.fr/api/equipmentstatusreports/equipmentstatusreports/

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```
Diesel Price Peg

This contract keeps in storage a reference
to the Diesel Price in USD
*/

pragma solidity ^0.4.0;
import "github.com/oraclize/ethereum-api/oraclizeAPI.sol";

contract DieselPrice is usingOraclize {

    uint public DieselPriceUSD;

    event newOraclizeQuery(string description);
    event newDieselPrice(string price);

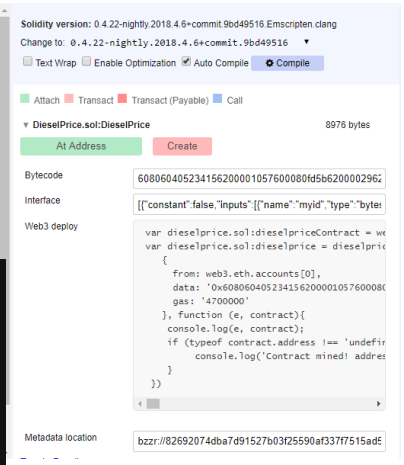
    function DieselPrice() {
        update(); // first check
    }

    function __callback(bytes32 my
        if (msg.sender != oracliz
        newDieselPrice(result);
        DieselPriceUSD = parseInt
        // do something with the
    }

    function update() payable {
        newOraclizeQuery("Oraclize
        oraclize_query("URL", "xm
    }
```

```
+ Ownable [Con]
   - Ownable
   - transferOwnership

+ ERC721 [Con]
   - totalSupply [Pub]
   - balanceOf [Pub]
   - ownerOf [Ext]
   - approve [Ext]
   - transfer [Ext]
   - transferFrom [Ext]
   - supportsInterface [Ext]
```




| Stage | Completed % | Planned | Actuals | Delay (in Days) |
|---|---|---|---|---|
| FloatEnquiry | 1 | 15-May-2018 | 12-Jun-2018 | 28 |
| Receipt of Offers | 2 | 22-May-2018 | 19-Jun-2018 | 0 |
| Final TBE | 4 | 11-Jun-2018 | 9-Jul-2018 | 0 |
| PlaceP.O/LOI | 5 | 18-Jun-2018 | 16-Jul-2018 | 0 |
| Start Manuf. | 5.1 | 19-Jun-2018 | 17-Jul-2018 | 0 |
| PS 1st Stage Approval | 10 | 12-Sep-2018 | 10-Oct-2018 | 0 |
| PS 2nd Stage Approval | 15 | 3-Oct-2018 | 8-Nov-2018 | 8 |
| Final Insp. Complete | 45 | 10-Oct-2018 | 14-Nov-2018 | -1 |
| Material Disp(1st Lot) | 50 | 17-Oct-2018 | 22-Nov-2018 | 1 |
| Del. at Site (1st Lot) | 55 | 30-Oct-2018 | 5-Dec-2018 | 0 |
| Material Disp(2nd Lot) | 60 | 1-Nov-2018 | 10-Dec-2018 | 3 |
| Del. at Site (2nd Lot) | 75 | 14-Nov-2018 | 23-Dec-2018 | 0 |
| Material Disp(Last Lot) | 80 | 26-Nov-2018 | 24-Dec-2018 | -11 |
| Del. at Site (Last Lot) | 95 | 9-Dec-2018 | 6-Jan-2019 | 0 |
| TPI ReleaseNote | 100 | 7-Feb-2019 | 31-Mar-2019 | 24 |

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# Functional Flow

Operator's existing Apps

Blockchain Components

Non - Blockchain Components


| Document Number | Document Description | Category | Float Enquiry (1 x) | Receipt of Offerr (2 x) | Final TBE (4 x) | Place P.O/LOI (5 x) | Start Manuf. (5.1 x) | PS 1st Stage Approval (10 x) |
|---|---|---|---|---|---|---|---|---|
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | ID | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1010 | PROCAR1010 |
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | P | 15/05/18 | 22/05/18 | 11/06/18 | 18/06/18 | 19/06/18 | 12/09/18 |
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | L | 12/06/18 | 19/06/18 | 09/07/18 | 16/07/18 | 17/07/18 | 10/10/18 |


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```


SAP Projects, SAP C – folders

Oracle Primavera

MS Project

Extract

Extract

Extract

1 Document/Project/ Material – Status/Performance

XLS/XML

Script

2 Data Modelling

XLS/XML

Generate

3 Enable REST API

Transform

4 Smart/Solidity Contracts

SOL

Deploy

JSON

5 Ethereum Platform

Decrypt

DATAFRAMES

6 Blockchain Blocks Extraction in R/Python

Integrate

7 Project/Contract Performance Visualization

**PMIS/CMS from Operator + Main Contractor**


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# Functional Flow

| Document Number | Document Description | Category | Float Enquiry (1 x) | Receipt of Offers (2 x) | Final TBE (4 x) | Place P.O/LOI (5 x) | Start Manuf. (5.1 x) | PS 1st Stage Approval (10 x) |
|---|---|---|---|---|---|---|---|---|
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | ID | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1000 | PROCAR1010 | PROCAR1010 |
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | P | 15/05/18 | 22/05/18 | 11/06/18 | 18/06/18 | 19/06/18 | 12/09/18 |
| 7234-17-56711 | HVAC / AIR COOLED CONDENSING UNIT | L | 12/06/18 | 19/06/18 | 09/07/18 | 16/07/18 | 17/07/18 | 10/10/18 |

1 2


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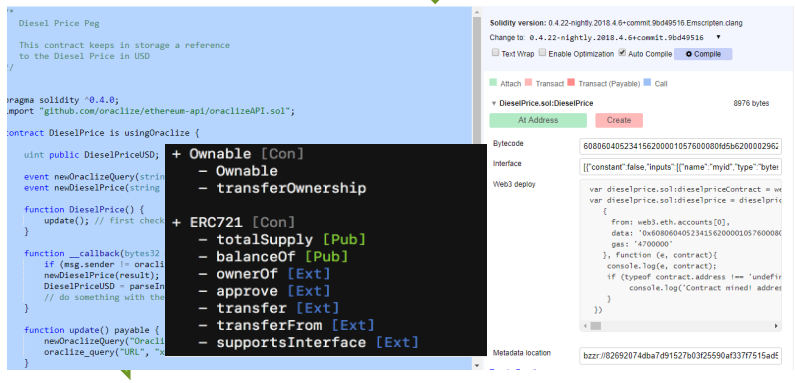
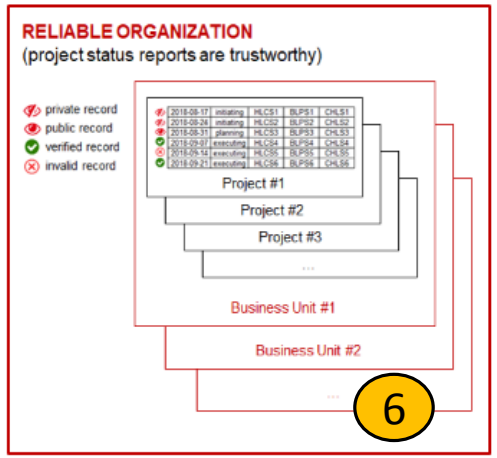
3


4 5




6


7

[Project/Contract Dashboard]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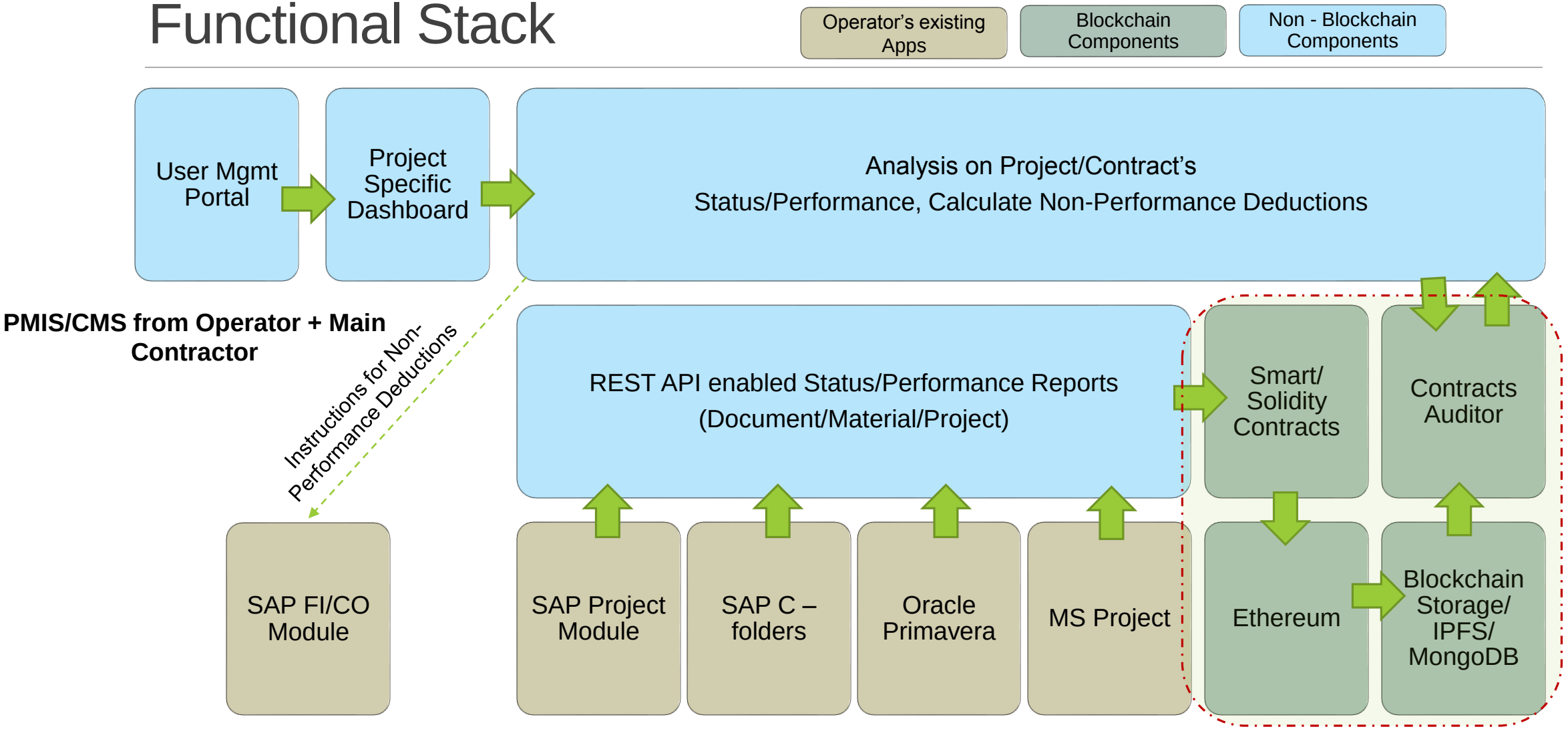
# Functional Stack





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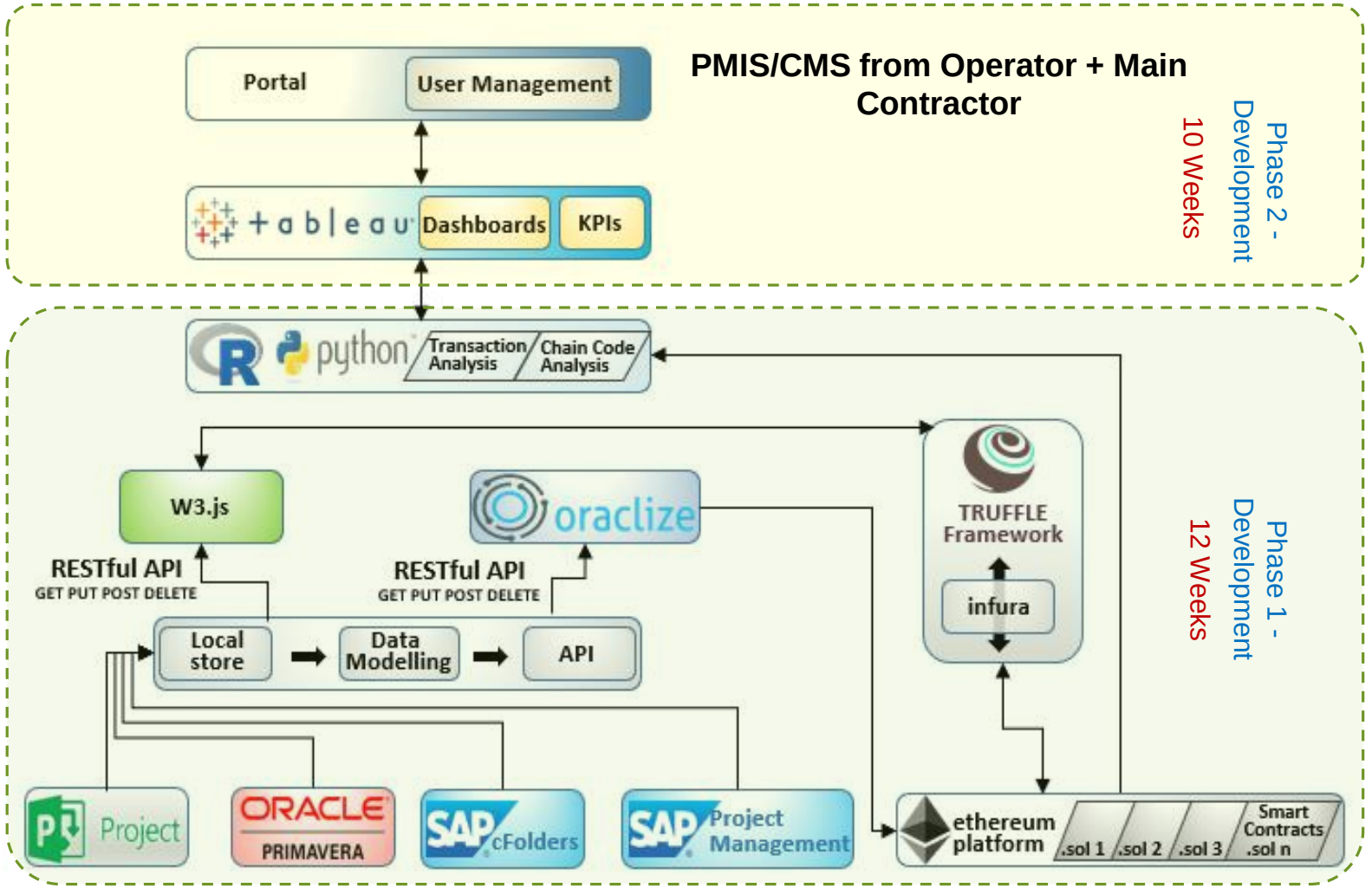
# Technical Stack




## Phase 2 – SoW

1. Enable user management module, so that contracts/projects are visible to authorized users only who are tagged to that project.
2. Showcase blockchain transactions through a visualization dashboard to procurement team
3. Instructions for Non-Performance Deductions to be passed to SAP FI/CO module

## Phase 1 – SoW

1. Export data from the Operator's Existing Applications
2. Perform Data Modelling and Enable API
3. Convert these project status/performance reports as Smart Contracts/Solidity Contracts
4. Store these contracts in the Ethereum platform
5. Allow contracts to be audited and analyzed as per Smart Contracts guidelines
6. Export smart contracts and perform transaction analysis, non-compliance, etc. in an analytics layer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# Software Details

Our recommended software stack will have following components

- ***Frontend Layer***
  - UI/UX - Angular.js/ web3.js
  - Identity and Login management – uPort
  - Dashboards – Tableau/ PowerBI
- ***Middle Layer***
  - Contracts - Solidity
  - Framework to compile, migrate & test smart contracts –Truffle, Oraclize
  - Contracts Auditor - Surya
  - Contracts data Analysis - R/Python
- ***Backend Layer***
  - Decentralized document storage – IPFS, MongoDB
  - Ethereum Infra Access - Infura


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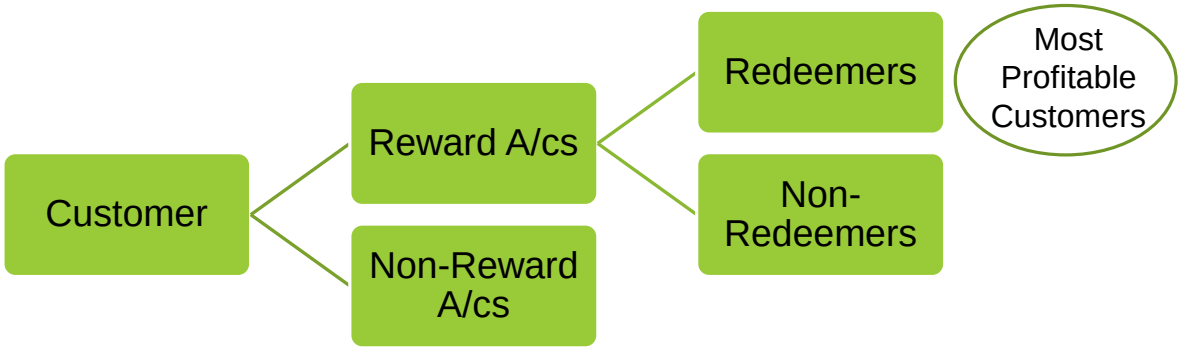
# Gamification of Reward Points using Blockchain

## Blockchain based Smart Rewards

# Target Segment : Retail Bank Customers




- ✓ Customer loyalty/rewards programs represent strategic investments for all types of B2C orgs including banks
- ✓ Reward Points Redeemers are the most profitable customers for a bank
- ✓ Loyalty schemes/Reward Points create customer loyalty

- ➢ Market surveys indicate banking customers across the world prefer immediate redemption (esp. the Millennials), exchange of reward points at the point of purchase across vendors and get satisfied managing it as an e-wallet.
- ➢ As per Deloitte, blockchain will allow secure and immediate redemption, creation and exchange of loyalty reward points across vendors, programs.
- ➢ **If the loyalty point management system is decentralized and customers allowed to use as per their preferences, then a better customer behavior can be derived,** and we will potentially get to know the preferred merchants as well as their network which allows cross-sell opportunities.

**Bank can use this solution as to understand their profitable customers better, induce more transactions and cross-sell 3rd party agents/partners services and goods.**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# Business Problem :
# High Cost To Serve (CTS) vs. Lower Customer Satisfaction %

A 3rd party survey which involved 40,000+ consumers in social media showed loyalty program are not evolving at the same pace as the digital age:

- **11% of loyalty programs offer personalized rewards** based on a customer's purchase history or location data
- 79% of loyalty programs use the mobile channel, and yet only **24% allow redemption through it**
- 16% of loyalty programs reward customers for activities, such as taking online surveys, rating and reviewing establishments or referring friends to the program.
- **14% employ gamification mechanisms to reward customers**

The following table sets forth, for the periods indicated, movement in provision for credit card/debit card/savings account reward points.

**ICICI Bank Annual Report - 2016**

₹ in million

| Particulars | Year ended March 31, 2016 | Year ended March 31, 2015 |
|---|---|---|
| Opening provision for reward points | 1,083.2 | 836.0 |
| Provision for reward points made during the year | 1,535.1 | 1,144.0 |
| Utilisation/write-back of provision for reward points | (1,200.8) | (896.8) |
| Closing provision for reward points[1] | 1,417.5 | 1,083.2 |

1. *The closing provision is based on the actuarial valuation of accumulated credit card/debit card/savings account reward points. This amount will be utilised towards redemption of the credit card/debit card/savings accounts reward points.*

| | |
|---|---|
| Creation of points | How many points are given out, for what behaviour – are you rewarded just for spending money, or for buying certain products or groups of products? |
| Distribution of points | How points can be distributed between points owners. |
| | By allowing points to be transferred or gifted to others, they are likely to migrate from people who won't spend them, to people who will. |
| | Increasingly, family schemes have appeared where points can be earned, transferred or spent within a family. |
| Value of points | By controlling what points can be redeemed for, how often, how much, and when, the value of the points is controlled by the company. Airlines change the value points fairly often, for example during sale periods where points can be redeemed to get deeper discounts. |

**Bank should make usage of reward points easier for customers so that brokerage received from transactions is greater than the liability created on its balance sheets (due to provision of reward points).**


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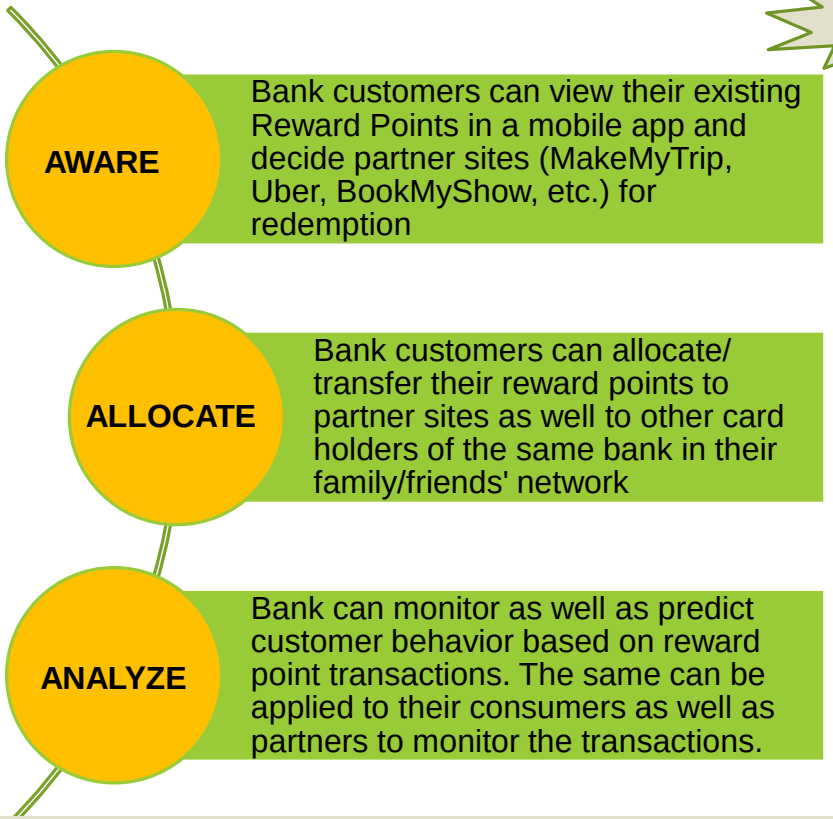
# Solution Functionalities




Key Feature 1

**Decentralizing Reward Points**

- Moving transactions of reward points outside the core banking system into a customized application (which can be accessed through a mobile) which is connected to a blockchain platform (In this case, IBM's Hyperledger)

Key Feature 2

**Instant Redemption of Reward Points**

- Allowing 3rd party merchant/partner sites to access the bank customer's allocated reward points and able to record the customer's confirmation as digital token in form of transaction IDs/blocks.

Key Feature 3

**Profiling of Customers Behavior**

- Allowing the bank to analyze the ledger transactions (from the blockchain platform) and finding out their customer's profile from their redemption pattern of reward points in near real-time.

**Helping Bank's customers to utilize reward points in real-time, allocate against their preferred merchant sites and help the bank to provide them more benefits aligned to their preferred purchase history**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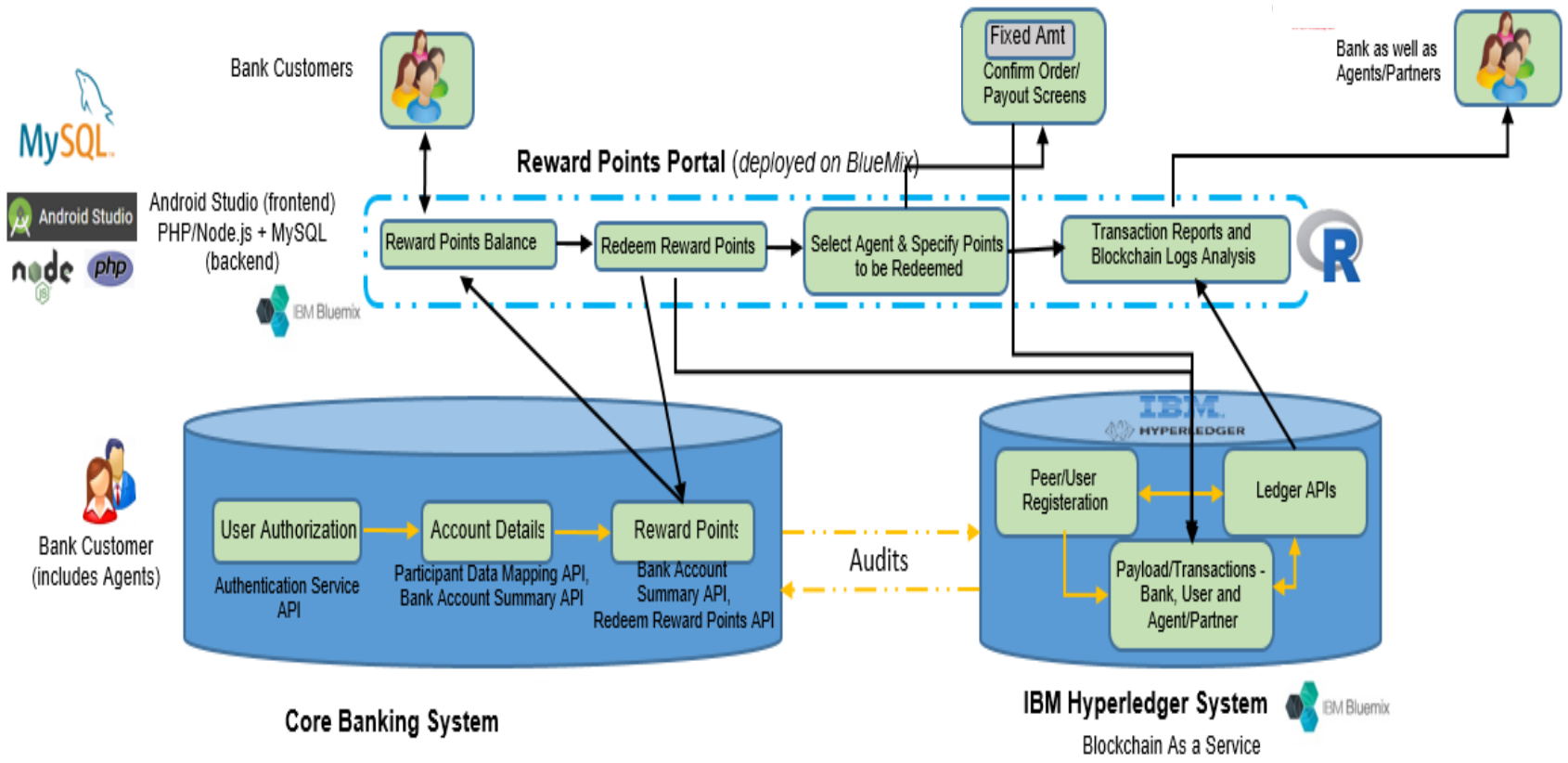
# Technology Stack




- From an android app, customer authentication is managed through MySQL (stores client ID+Access Code) via a backend PHP running on Apache Webserver. If a correct match is found, the backend PHP generates an access token by calling up the Open Bank API from bluemix.
- This access token is used to use other banking APIs and is shared on the Reward Points Portal App.
- Customers can redeem their points directly from the portal (can be accessed through the mobile app) and select partner/agent sites for points reduction.
- Any redemption of reward points (in the portal as well as at the partner sites) will create payload and trigger transactions to be logged in the IBM Hyperledger in real-time as a block.
- And these transactions/logs are then fetched from the IBM Blockchain system into R and decoded for the users (bank/agent) to monitor the transactions

**Managing Reward Points in a decentralized ledger and "As a Service" delivery mode.**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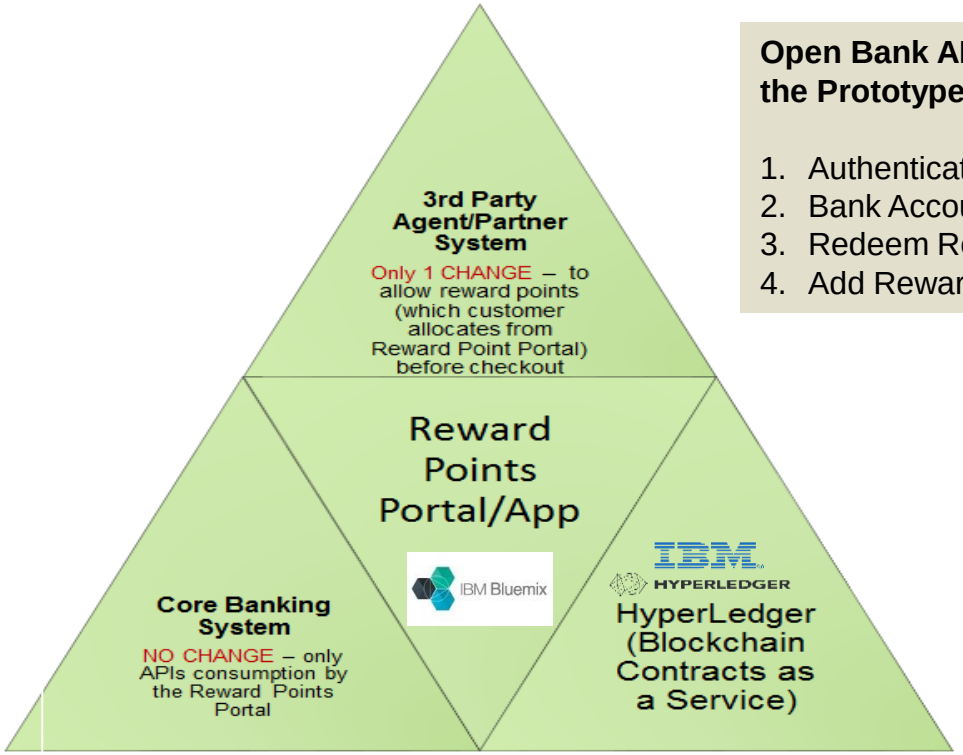
# Proposed Solution:
# Smart Rewards on Blockchain Platform

1. Authenticate User via android app to generate a token (Authenticate User API)
2. Display Bank Account Summary with Reward Points (Bank Account Summary API)
3. Allow the User to Redeem (Redeem Reward Points API)
4. Allow the User to Redeem through a merchant site by pre-allocation set by the user
5. Any redemption will trigger a block/transaction in the connected IBM hyperledger
6. All reward points related transactions *(redemption, addition from merchants, etc. are logged)*
7. Decode these blockchain transactions using R
8. Extract the payload and analyze the transactions
9. Allow any user (Bank, Agent, Consumer) to monitor and understand these transactions

Flow Ends.




**Open Bank APIs used in the Prototype/1st MVP –**

1. Authenticate User
2. Bank Account Summary
3. Redeem Reward Points
4. Add Reward points

**No changes to the core banking as well as the agent/partner systems.**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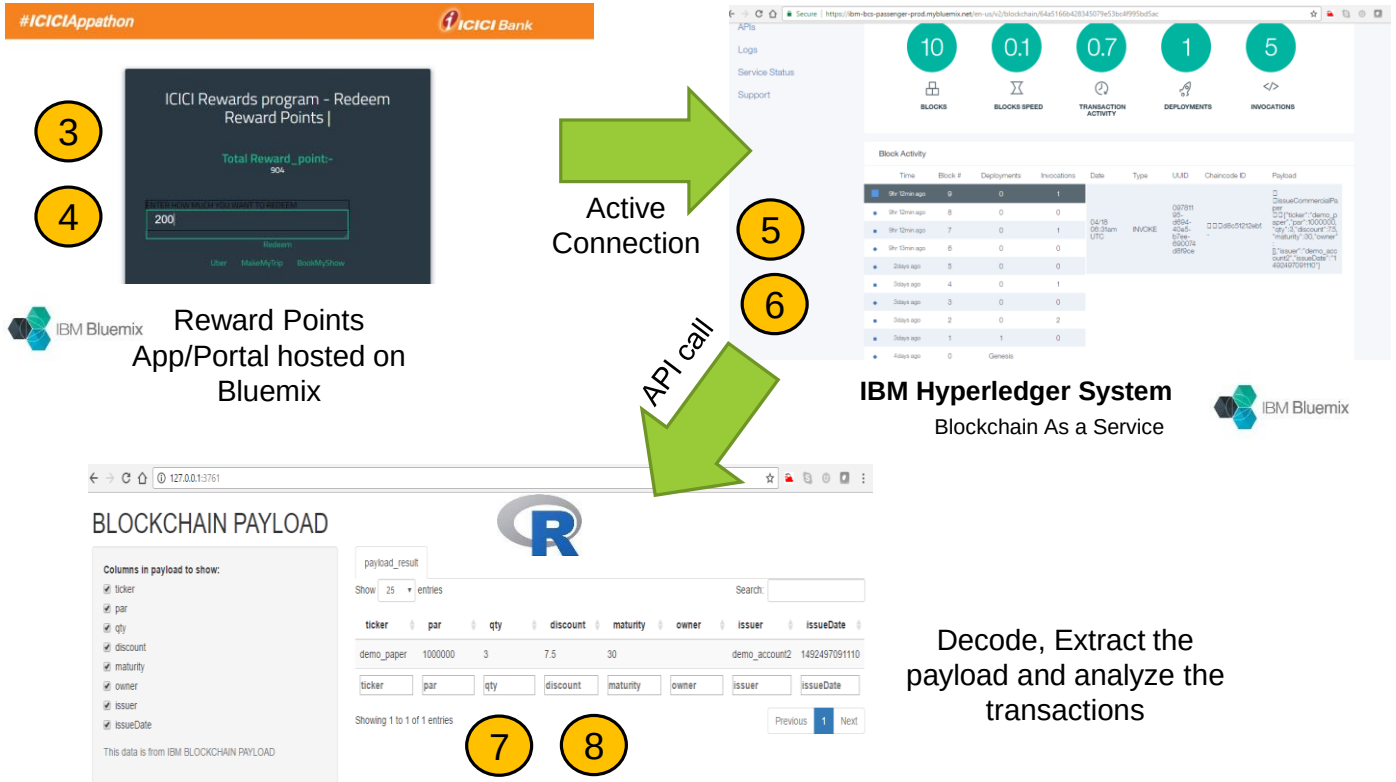
# Benefits

1. Improve customer engagement by allowing instant redemption of loyalty/reward points across authorized merchant sites
2. Reduce the IT cost of loyalty program management by making the administration outside the core banking system and on a distributed ledger framework using IBM HyperLedger's Blockchain APIs
3. Encourage customers for more transactions with their preferred merchants by personalizing and gamification of the reward points system
4. Increase cross-selling opportunities by allowing to share/transfer reward points in the customer networks
5. Improve the lifetime value as well as retention period of high value customers.




**Sharing the visibility of the R&R with customers and merchants in a distributed common platform.**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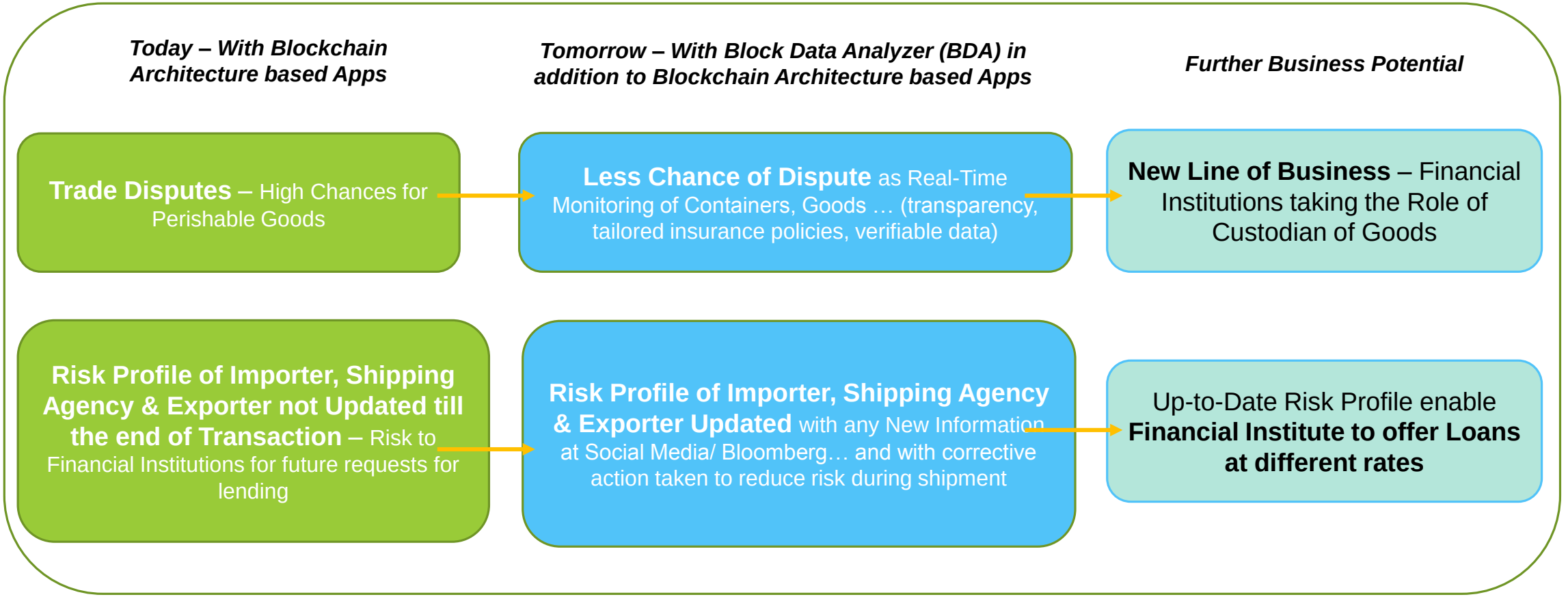
# Analyzing Trade Finance Services

## Blockchain Analytics as a Service (BAaaS)

# Business Value to Bank – Trade Finance





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# Trade Finance - Smart Contracts

- ✓Following the sale agreement, the financial agreement is shared with the import bank through a smart contract
- ✓The import bank reviews the arrangement, drafts the terms of the letter of credit and submits it to the export bank for approval
- ✓The export bank reviews the letter of credit; once approved a smart contract is generated to cover the terms and conditions of the letter of credit
- ✓The exporter digitally signs the letter of credit within the smart contract to initiate shipment
- ✓Goods are inspected by a third-party organization and the customs agent in the country of origin (all requiring a digital signature for approval)
- ✓The goods are transported by freight from Country A to Country B with IoT tracking in place for the parameters such as temperature, humidity, etc.
- ✓Any exceptions are logged as contract breaches in the blockchain platform.
- ✓Goods/Consignments are inspected by local customs agents prior to being received by the importer
- ✓The importer digitally acknowledges receipt of the goods, which initiates payment from the import bank to the export bank via a smart contract
- ✓The bank can monitor transactions in real time and receive specific alerts during these transactions. The transaction history is available on the ledger and can be continuously reviewed by the bank authorities.


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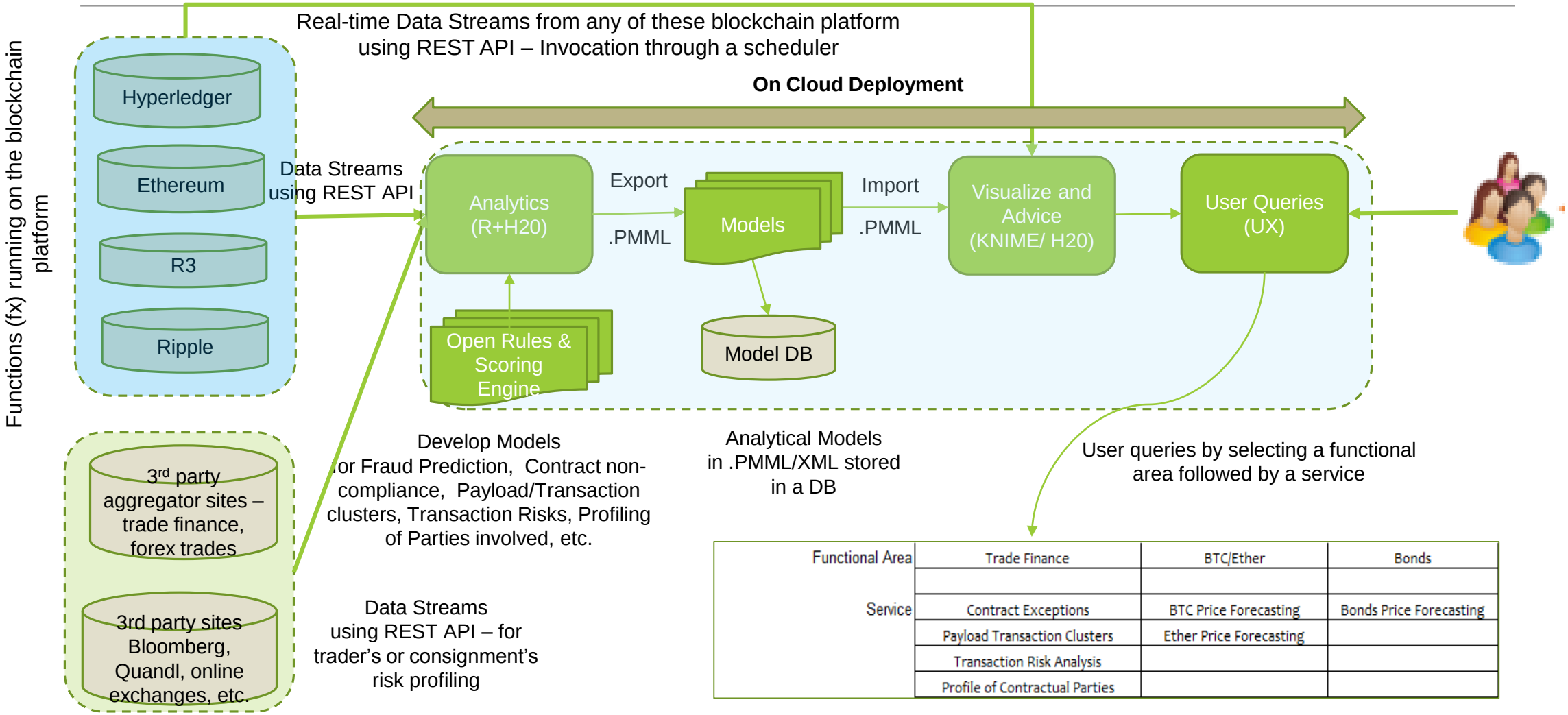
# Technical Architecture




| Functional Area | Trade Finance | BTC/Ether | Bonds |
|---|---|---|---|
| | | | |
| Service | Contract Exceptions | BTC Price Forecasting | Bonds Price Forecasting |
| | Payload Transaction Clusters | Ether Price Forecasting | |
| | Transaction Risk Analysis | | |
| | Profile of Contractual Parties | | |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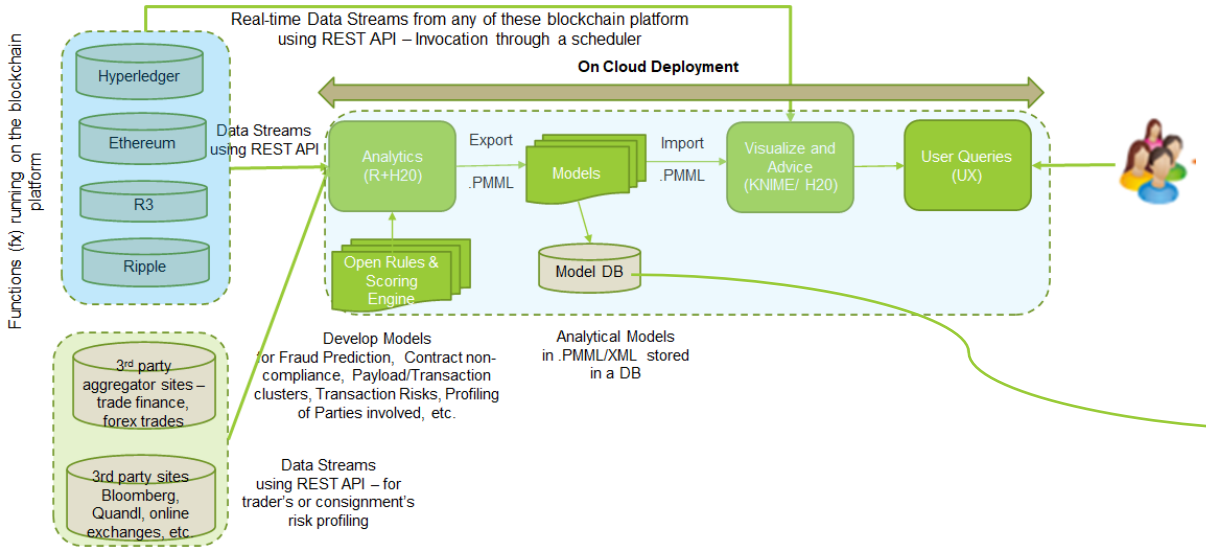
# Application of Models




| Application | Models |
|---|---|
| • Fraud Prediction | • M1 – K-Nearest Neighbors<br>• M2 – Random Forest<br>• M3 – SVM(Support Vector machines) |
| • Fraud Detection | • M4 – Anomaly Detection(H2o Deep Learning) |
| • Contract non-compliance | • M5 – NA |
| • Payload/Transaction clusters | • M6 – K- means Clustering |
| • Transaction Risks | • M7 – Logistic Regression<br>• M8 – Decision Tree |
| • Price Forecasting | • M9 – ARIMA(Autoregressive Integrated Moving Average) |
| • Risk Profiling | • M10 – Logistic Regression<br>• M11 – Gradient Boosting |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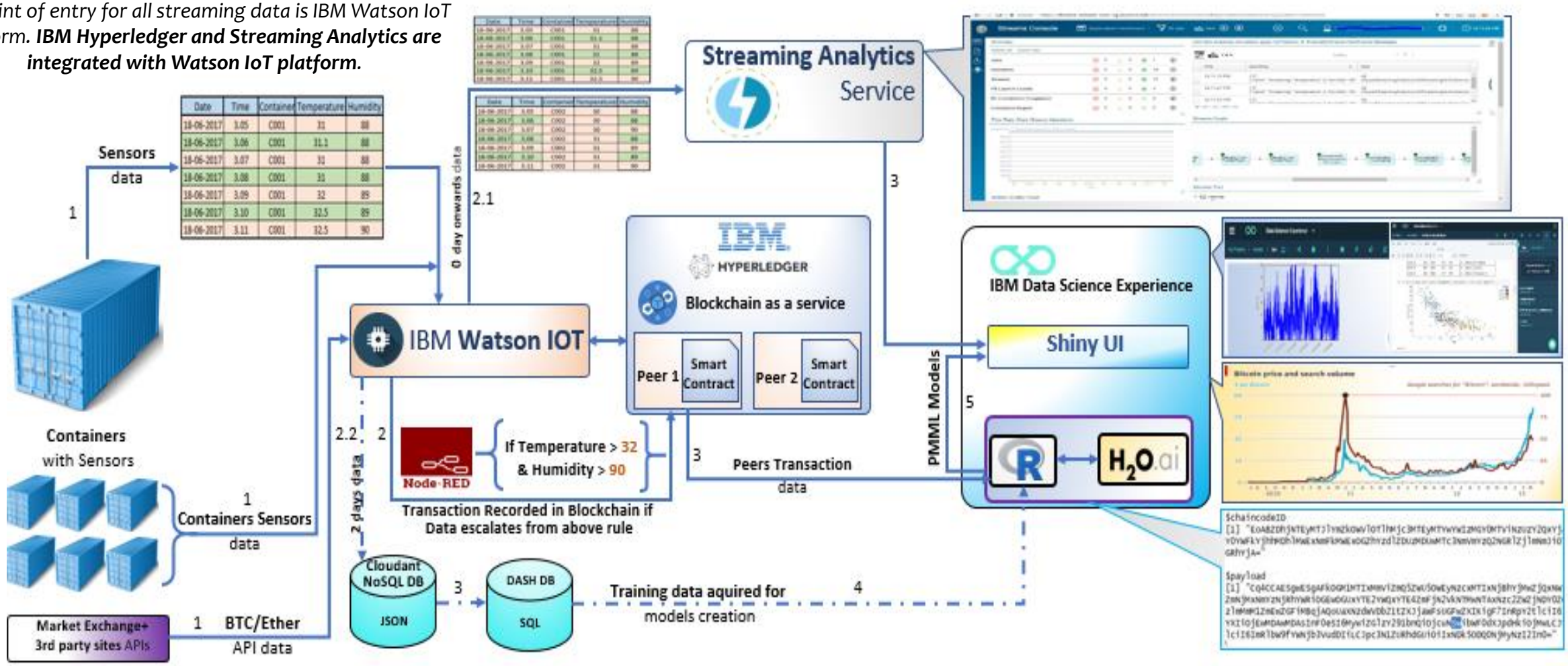
# Sample Use Case - Trade Finance POC

*The point of entry for all streaming data is IBM Watson IoT platform.* ***IBM Hyperledger and Streaming Analytics are integrated with Watson IoT platform.***





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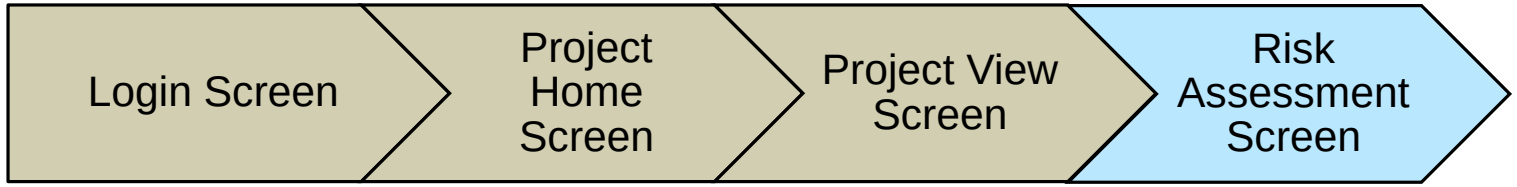
# Sample UI/UX - Risk assessment in Trade Finance




| Source (Internal/External) | Systems | Source | Predicted Value | Applied Model | Confidence % | Sentiment | Weightage |
|---|---|---|---|---|---|---|---|
| Internal | Watson IoT | Internal IP | # of Actual Contract Exceptions from IoT feeds (9) | N/A | N/A | Negative | -1 |
| Internal | R(running in DSx) | Internal IP | # of Predicted Contract Exceptions | Logistics Regression | 0.650000012 | Negative | -1 |
| Internal | IBM Hyperledger | Internal IP | # of Changes to the Initial Payloads (7) | N/A | N/A | Negative | -1 |
| Internal | Streaming Analytics | Internal IP | # of Times Sensor Feeds did not reach Streams (37) | N/A | N/A | Negative | -1 |
| Internal | R(running in DSx) | Internal IP | # of Predicted Unauthorized Payload Transactions | GLM | 0.730000012 | Negative | -1 |
| External | Bloomberg (Goods Category View) | https://www.bloomberg.com/ | 5 Positive, 2 Negative (Headlines) | Sentimental Analysis | 0.750011001 | Positive | 1 |
| External | Reuters | http://www.reuters.com/ | 3 Positive,2 Negative (Headlines) | Sentimental Analysis | 0.680000012 | Positive | 1 |
| External | Twitter | https://twitter.com/ | Customer, Competition Sentiment (Tweets) | Sentimental Analysis | 0.730000012 | Positive | 1 |
| | | | | | | Total Score | -2 |
| | | | | | | **Overall Negative** | -2 |

Re-Evaluate

From external sources, we will continue performing data mining for sentiment analysis on 3 broad categories

- Anomalous transactions identified based on historical transactions and profiles stored in govt's export/import open data sites
- Data gathering of client relationships and transaction networks
- Identification of trade-specific risk factors related to shipping vessels, containers and goods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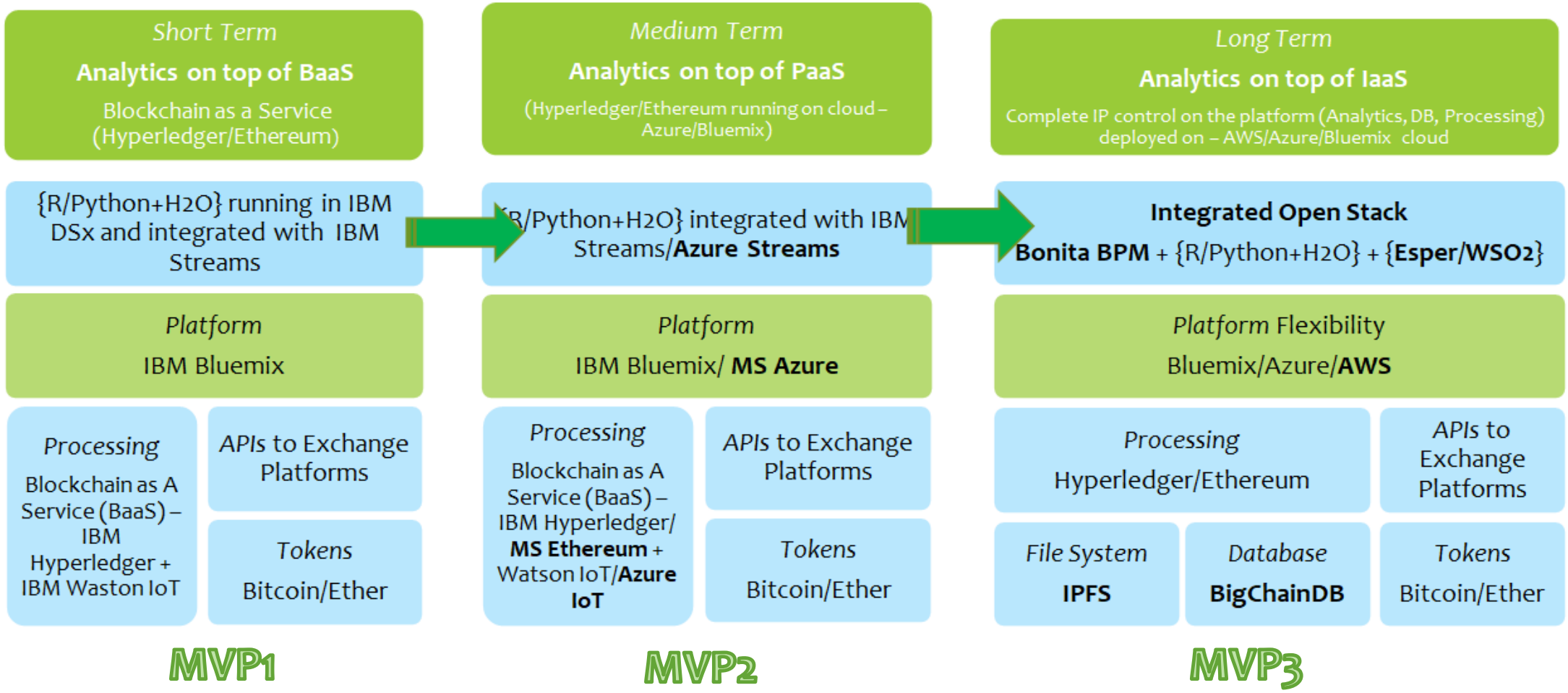
# Typical Pilot Roadmap for BAaaS





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# Audit of Smart Contracts

## Smart Contracts Analyzer (SCA)

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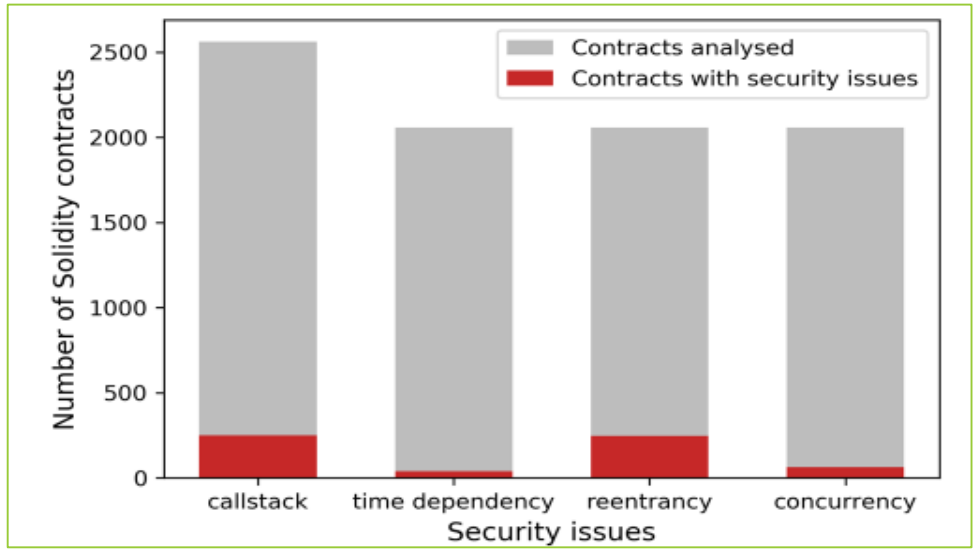


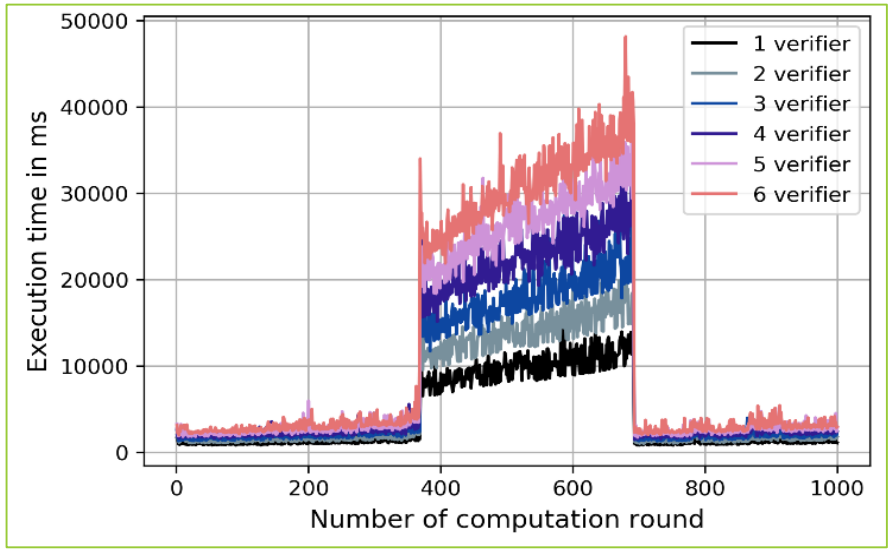


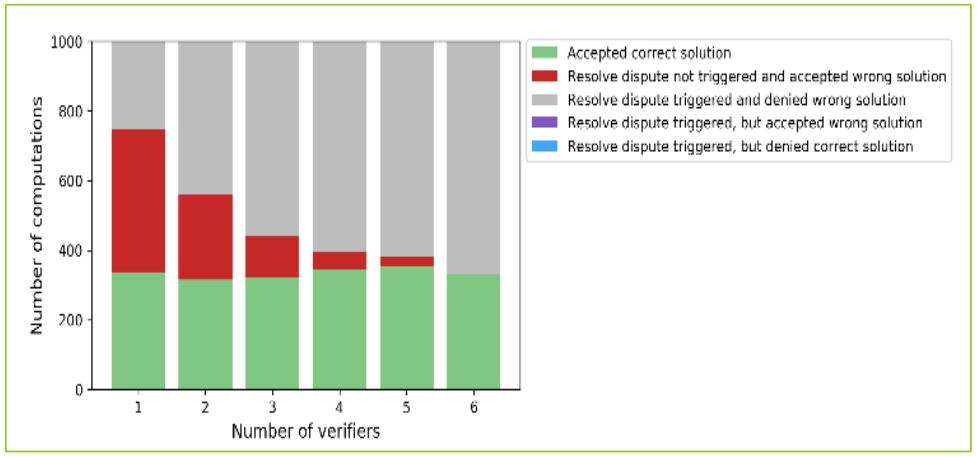


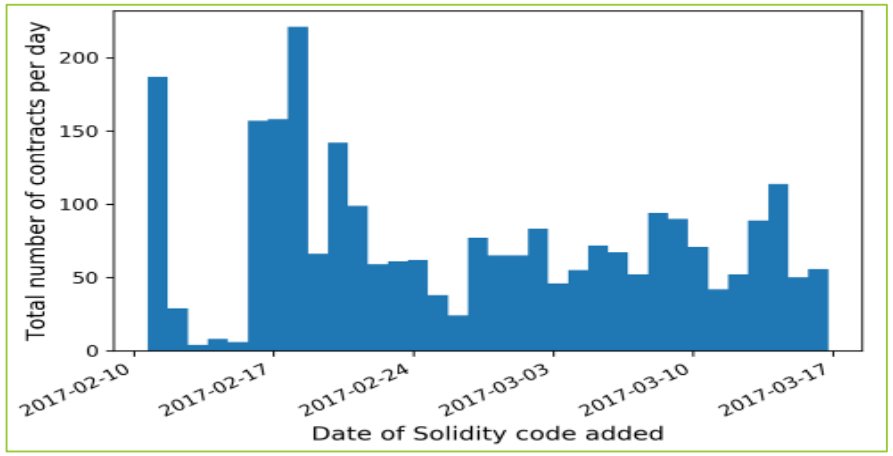



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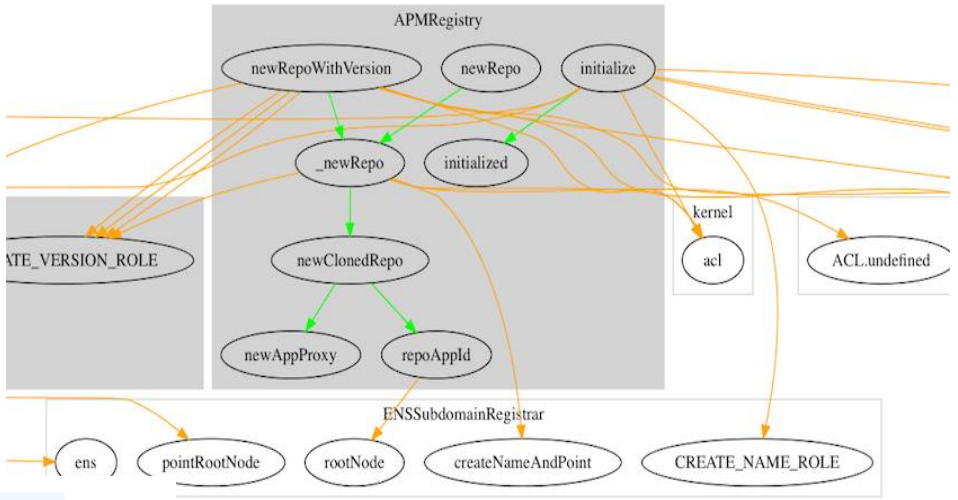
# Smart Contracts Analyzer (SCA)

```
+ Ownable [Con]
   - Ownable
   - transferOwnership

+ ERC721 [Con]
   - totalSupply [Pub]
   - balanceOf [Pub]
   - ownerOf [Ext]
   - approve [Ext]
   - transfer [Ext]
   - transferFrom [Ext]
   - supportsInterface [Ext]
```




Exchange-DepositWithdraw.sol

```
37          tokens[token][msg.sender] = safeSub(tokens[token][msg.sender], amount);
38          if (!Token(token).transfer(msg.sender, amount)) revert();
39          Withdraw(token, msg.sender, amount, tokens[token][msg.sender]);
40      }
41
42      function order(address tokenGet, uint amountGet, address tokenGive, uint amountGive,
43        bytes32 hash = sha256(this, tokenGet, amountGet, tokenGive, amountGive, expires, no
44        orders[msg.sender][hash] = true;
45        Order(tokenGet, amountGet, tokenGive, amountGive, expires, nonce, msg.sender);
46      }
47
48      function trade(address tokenGet, uint amountGet, address tokenGive, uint amountGive,
49        if (tokenGet == 0 || tokenGive == 0) revert();
50        //amount is in amountGet terms
51        bytes32 hash = sha256(this, tokenGet, amountGet, tokenGive, amountGive, expires, no
52        bytes memory pubkey = new bytes(33);
53        pubkey[0] = 2;
54        for (uint8 i=0;i<32;i++)
55        {
```

| Errors | Lines |
|---|---|
| Deprecated constructions | |
| Compiler version not fixed | |
| Redundant fallback function | |
| Revert-function in the body of the conditional operator if | |
| Implicit visibility level | |

```
└─ APMRegistry::_newRepo
   ├─ APMRegistry::newClonedRepo | [Int] 🔒
   │  ├─ APMRegistry::newAppProxy | [Pub] !
   │  └─ APMRegistry::repoAppId | [Int] 🔒
   │     └─ ENSSubdomainRegistrar::rootNode
   ├─ ACL::createPermission | [Ext] !
   │  ├─ ACL::hasPermission | [Pub] !
   │  │  └─ ACL::hasPermission | [Pub] !   : ..[Repeated Ref]..
   │  └─ ACL::_createPermission | [Int] 🔒
   │     ├─ ACL::getPermissionManager | [Pub] !
   │     │  └─ ACL::roleHash | [Int] 🔒
   │     ├─ ACL::_setPermission | [Int] 🔒
   │     │  └─ ACL::permissionHash | [Int] 🔒
   │     └─ ACL::_setPermissionManager | [Int] 🔒
   │        └─ ACL::roleHash | [Int] 🔒
   ├─ IKernel::acl | [Pub] !
   ├─ Repo::CREATE_VERSION_ROLE
   └─ ENSSubdomainRegistrar::createNameAndPoint | [Ext] !
      ├─ ENSSubdomainRegistrar::_createName | [Int] 🔒
```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Applied Analytics for Digital Enterprises

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