HYPERLEDGER FORUM

June 8–10, 2021 | Virtual Experience

#hyperledgerforum



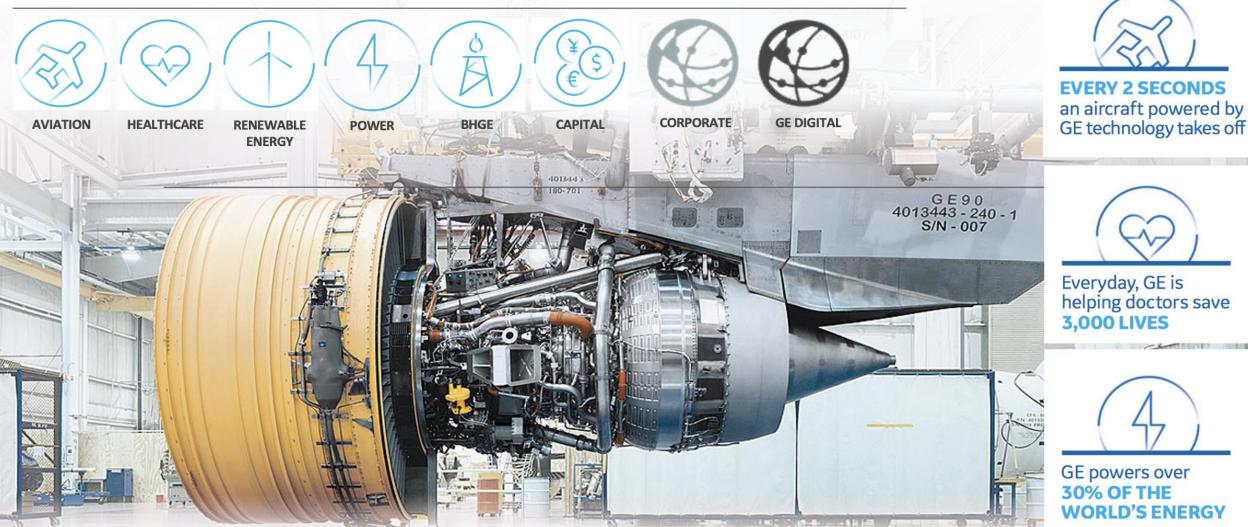
The "iDeAL" POC

a Wing-to-wing Proof of Concept for an Inter-company Distributed Accounting Ledger Gary Crisci, Principal Architect, General Electric



General Electric Company – GE

Imagination at work



"Our primary focus must be on delivering outcomes. We don't define that solely by the number of gas turbines, wind turbines, jet engines, or CT scanners we manufacture. The ultimate purpose of our work is the children in distant villages who get access to electricity for the first time, the travelers who get home safely, and the patients who receive better diagnoses and treatments in the moments that matter most. When our teams understand customer needs and deliver outcomes for them, we always end up in a good place for our employees and our owners."

Agenda

- Problem statement and solution overview
- Introduction to Blockchain and Hyperledger Fabric
- Solution Architecture
 - Oracle blockchain as a service platform (OBP)
 - Data Integration
 - Data warehouse
 - Analytics
 - Identity management
- User experience
- Closing and Q&A

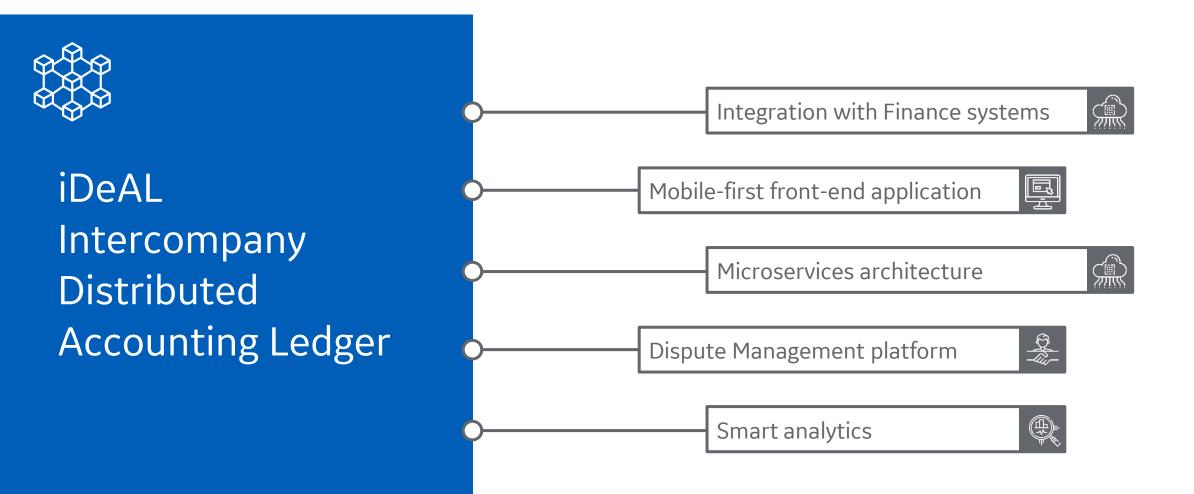




Modernize GE's Internal Billing System (IBS). IBS is a 25 years old mainframe-based application with an average annual flow of 4MM inter-company invoices. As many mainframe apps it brings a high TCO, an increasing technical debt and a reduced talent pool with specialized skills.



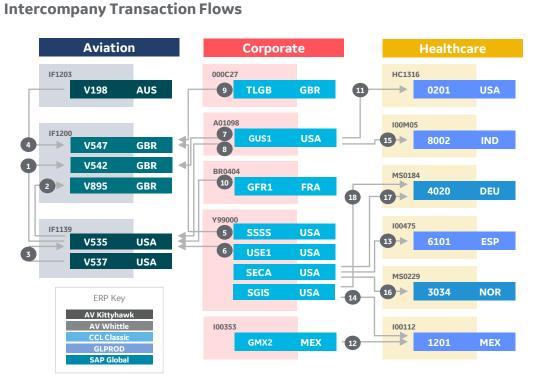
The art of the possible for inter-company transformation



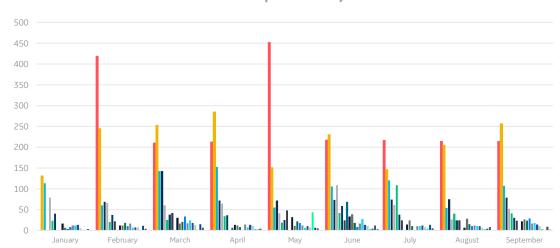


Current inter-company transaction flow

High Level: In-Scope Entities, and Transactions Flows & Sizing



Intercompany Pairs: Number & Value of Transactions Per Month



Transactions per Month by Pair

■16 ■12 ■11 ■13 ■3 ■1 ■14_FX ■17 ■15 ■5_FX ■4_PL ■4_FX ■2 ■9_PL ■8 ■7 ■10 ■14_PL ■18 ■6 ■5_PL



Solution design aligned to Intercompany Business Capabilities Model



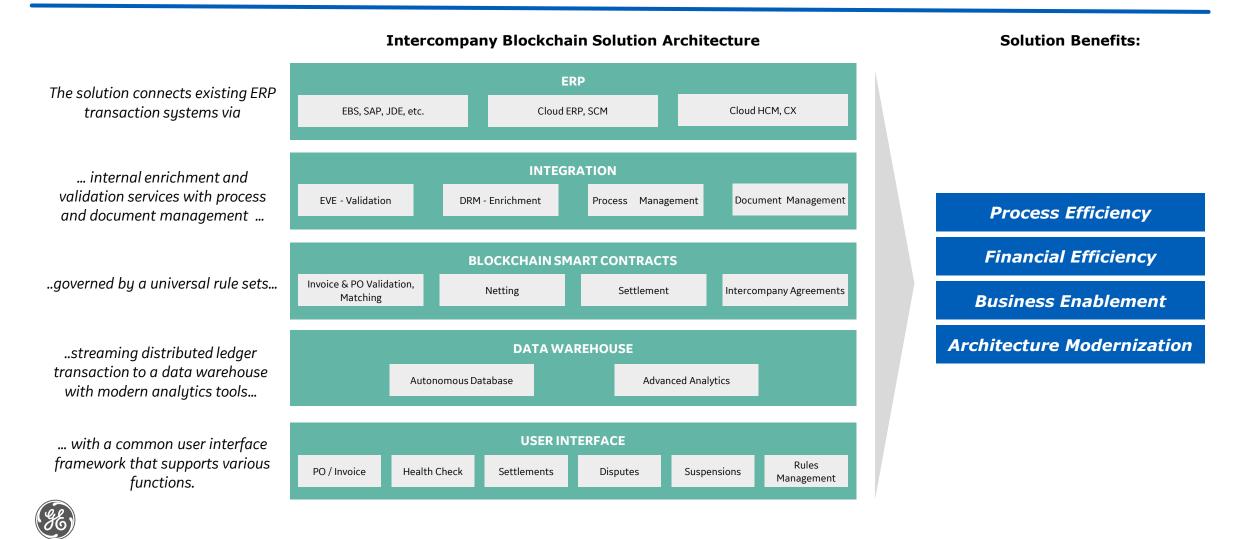
The Intercompany Business Capabilities Model was created in collaboration with **functional users** and **process leaders**. It illustrates the activities that the Intercompany function should be able to perform regardless of the technology.

This model was used to drive the technology assessments that will be described in the upcoming pages.



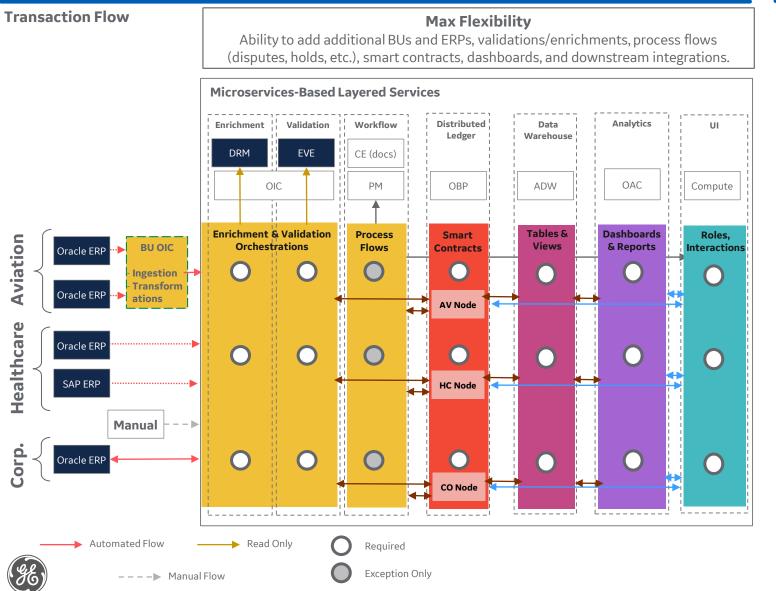
Blockchain solution design overview

The Blockchain solution connects **independent ERP** systems through an integration layer to applications **governed by** smart contract **business rules** and a web-based user interface



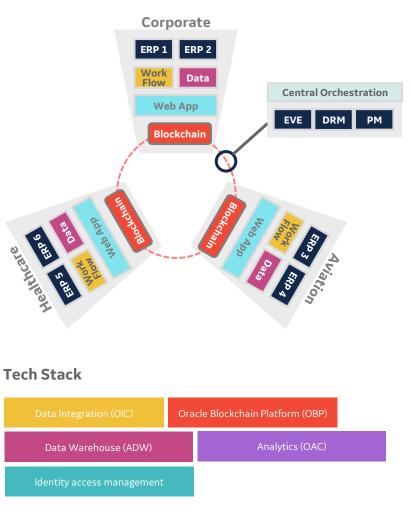
iDeAL Solution architecture

Transaction Flow and Distributed Network Architecture



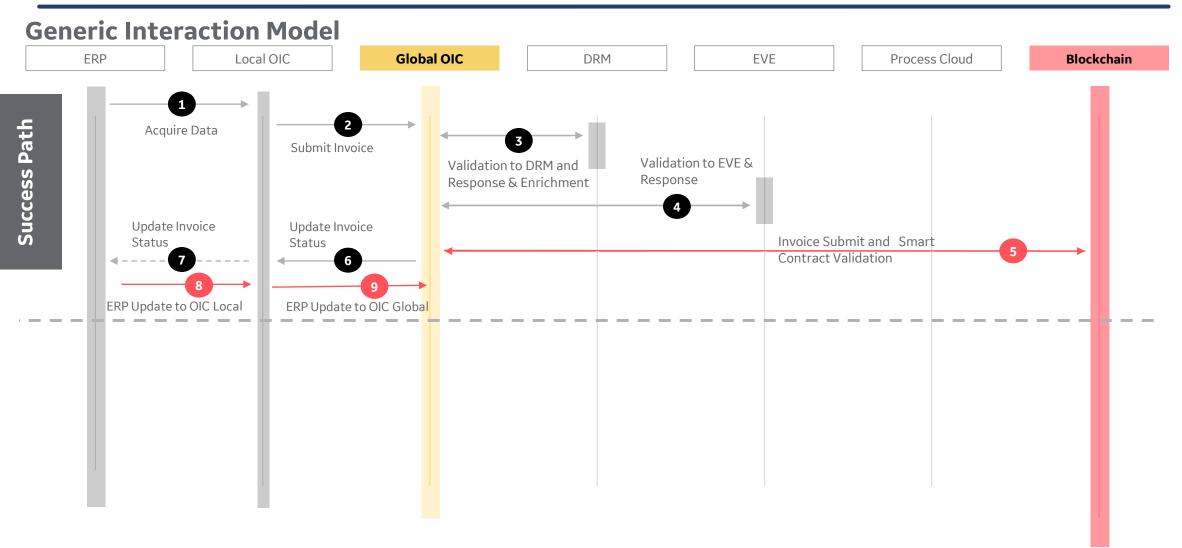
Distributed Network Configuration

Businesses share a set of common, secure communication protocols that automate processes across the ERPs..



Blockchain Process Flow & Interaction Model

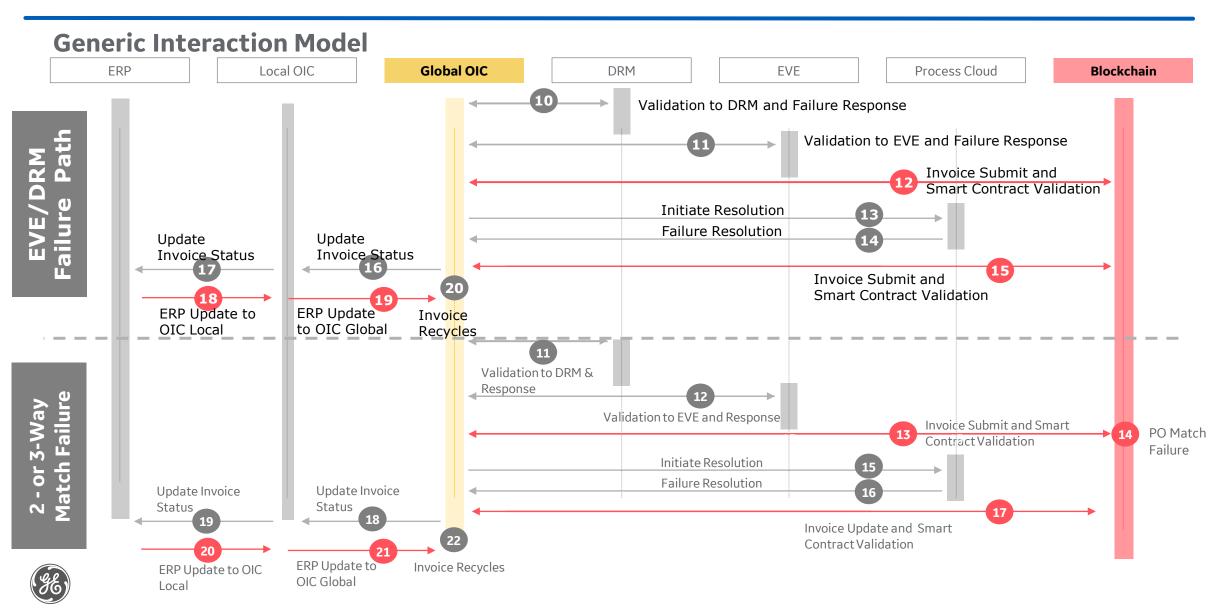
Transaction recordation, business process/logic optimization, DRM/EVE Validation and Enrichment





Process Flow & Interaction Model: Failure scenarios

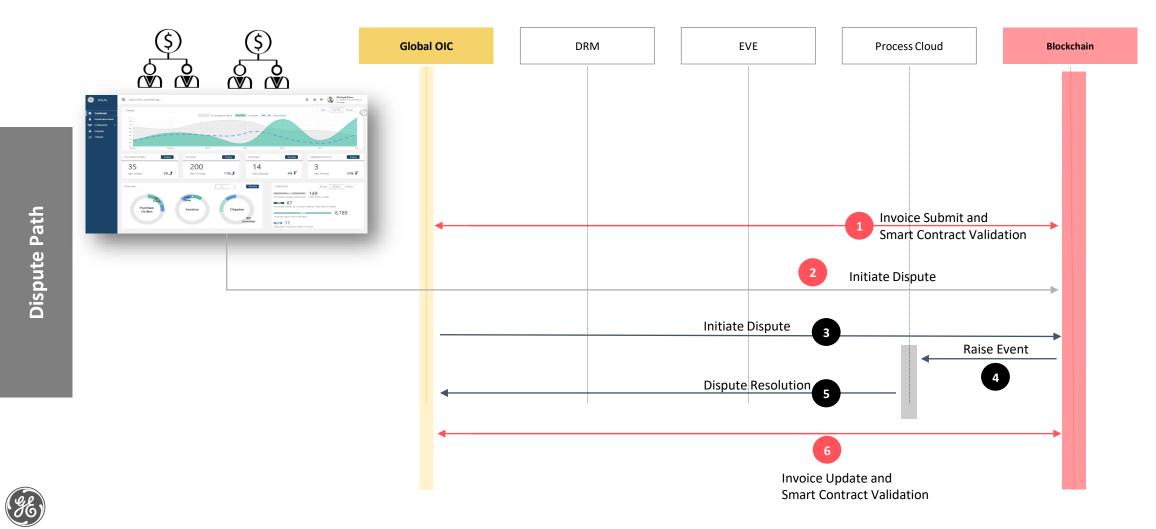
Transaction recordation, business process/logic optimization, 2 - or 3-Way Match Failure



Blockchain Process Flow: Dispute Management

Initiating and resolving disputes

Generic Interaction Model



Why Blockchain?

Blockchain Unique Value Proposition



Trust

Non-repudiation reduces risk of fraud

Tamper-proof / tamper evident records

Process integrity based on pre-agreed rules



Transparency

Single source of truth

Optimized decisionmaking

Self regulating

Full audit history



No Intermediaries

Improved consumer experience

Faster transactions

Lower transaction cost



Automation

Real-time reconciliation and settlement

Continuous visibility into relative positions

Eliminate risk of human errors



Blockchain has moved beyond the hype, and is poised to deliver value to enterprise

Spectrum of Blockchain Models

Enterprise Focus

	Public Blockchain	Private Blockchain	Federated/Consortium Blockchain	Public/Permissioned Blockchain
Access	 Anyone 	 Single organization 	 Multiple selected organizations 	 Multiple selected organizations
Participants	PermissionlessAnonymous	PermissionedKnown identities	PermissionedKnown identities	Permissioned writers"Public" read access
Security	 Consensus mechanism Proof of Work / Proof of Stake 	 Pre-approved participants Voting/multi-party consensus 	 Pre-approved participants Voting/multi-party consensus 	 Pre-approved participants update the ledger Flexible policies for read access
Transaction Speed	 Slow 	 Lighter and faster 	 Lighter and faster 	• Lighter and faster

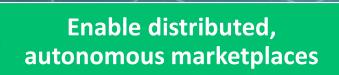


Blockchain is not a solution to all problems

Qualifying questions:

- Do your business processes cross divisional or organizational boundaries?
- Do cross-system discrepancies that impact operations?
- Is there less than full trust among transacting parties?
- Do you rely on intermediaries, possibly charging expensive fees, adding risk or delay?
- Do you rely on periodic (batch) reconciliations?
- Is there a need to improve traceability or audit trail?
- Do you need real time visibility into multi-party transactions or processes?

Typical Enterprise Scenarios



Reduce friction in business transactions & reconciliations

Securely maintain and share decentralized records



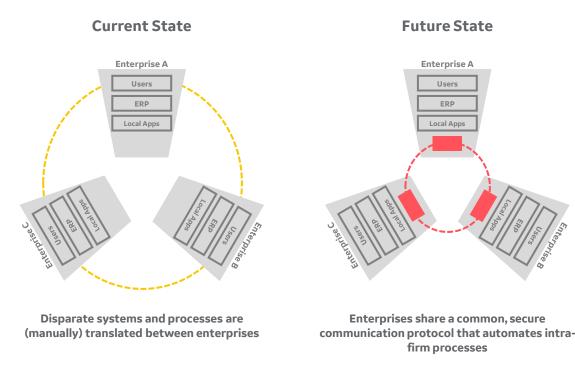


Enterprise Blockchain in action

Enterprise Blockchain is a type of corporate Blockchain implementation that focuses on the streamlining and automation of operational processes within a secure network of participants

Current State versus a Blockchain enabled ecosystem

• Blockchain creates a single source of truth for multi-organization interactions and business processes



Manual or Exceptionprone Process

Blockchain Node



Enterprises share a common, secure communication protocol that automates intra-firm processes

Key Characteristics of an Enterprise Blockchain

- An enterprise Blockchain is **permissioned; only authorized/enrolled transacting parties can participate**
- Transaction requests are cryptographically signed by their originating members for non-repudiation
- Codified business rules on the blockchain (smart contracts) enable **autonomous transaction processing,** resulting in signed RWSets
- Multi-party consensus is used to agree on the RWSets and the transaction ordering before its committed to the ledger
- Transaction data is stored in cryptographically linked data blocks on participant nodes; signed data cannot be modified without detection
- Transaction information can be stored only on the nodes owned by parties specific to a transaction, but a hash to prove the transaction can be stored in a shared ledger
- There is **no single point of failure**, as data blocks are replicated on participant blockchain nodes

Hyperledger Fabric

Hyperledger Fabric (HLF) is a robust and flexible blockchain network architecture that provides enterprise-ready security, scalability, confidentiality and performance. Its unique implementation of distributed ledger technology ensures data integrity and consistency, while delivering accountability, transparency and efficiency. As a permissioned network, the HLF delivers a trusted blockchain network, where members are assured that all transactions can be detected and traced by authorized regulators and auditors.

Fabric offers:

- ✓ A permissioned blockchain model with membership services
- Programmability containerized smart contracts for automating business processes
- Independent Ordering Service delivers transaction blocks consistently to peers in the network and provides greater scalability
- ✓ Channels and Private Data Collections for confidentiality and privacy
- Modular architecture with pluggable data store, consensus protocols, and multiple providers of membership services
- ✓ No cryptocurrency required!





Also known as chain-codes

- A data schema and a set of business rules defined in code that describes all the conditions and steps pre-agreed by the participants for a specific transaction
- Transactions that meet the criteria of the smart contract as executed by multiple member nodes are considered valid and are automatically committed to the ledger without further intervention required
- Foundation of "algorithmic trust"





Smart Contract Functions and Logic for Reconciliation and Netting

Smart contract design and process logic

Smart Contract Functions

- 1
- PO Submission and Validation
- Checking Duplicates
- Updating Status



3

Receipt Submission and Validation

- Check if PO Exists
- Validating and Ingesting Receipts
- Updating Status

Invoice Submission and Validation

- EVE Validation
- DRM Validation
- Update Status

2/3 Way Match

- 2/3 Way Match (Reconciliation)
- Aggregate Type
- Legal Entity Type

5 Intercompany Agreement

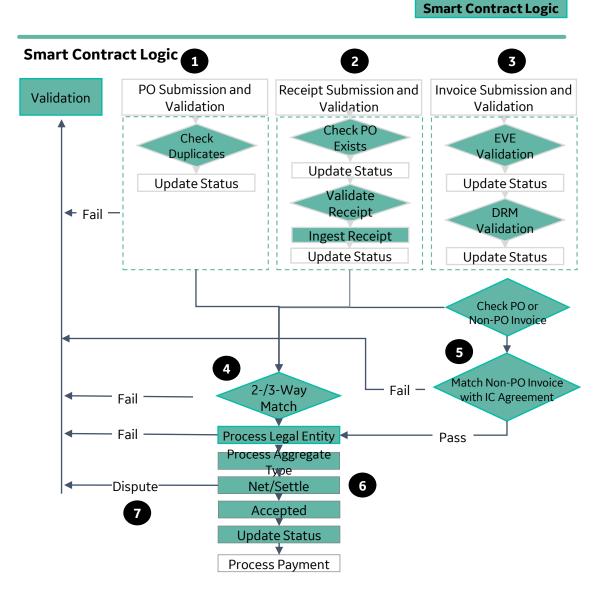
- Check ICA Exists
- Check ICA Invoice Matches
- Update Status

Real-time Netting and Settlement

- Match 2/3 way POs and ICAs
- Check Invoice Receipt Type
- Check Net Settlement Exists
- Update or Create New Settlement

Dispute Handling

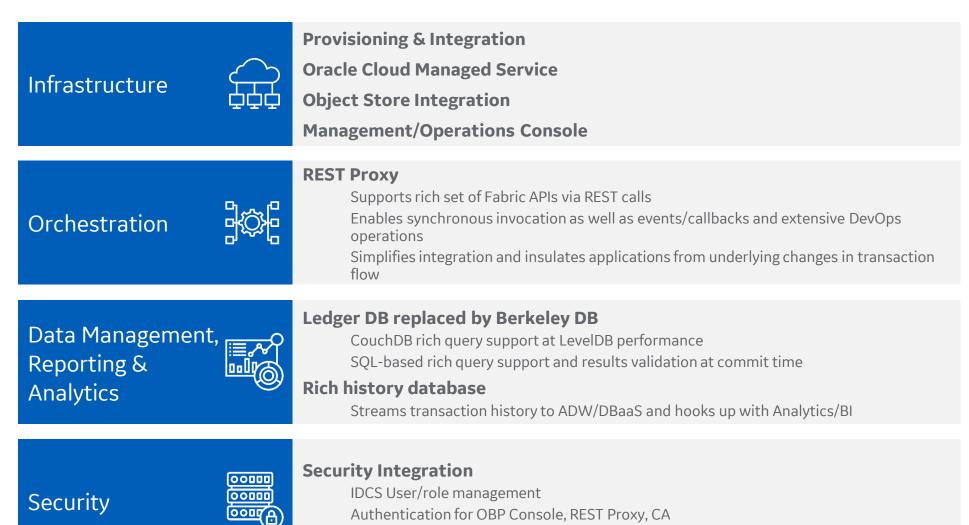
- Check Status If Dispute allowed
- Update Invoice Data
- Update Settlement Data
- Add to Success or Failure List



Flow Key



Open Source Hyperledger Fabric with Key Oracle Value-Add



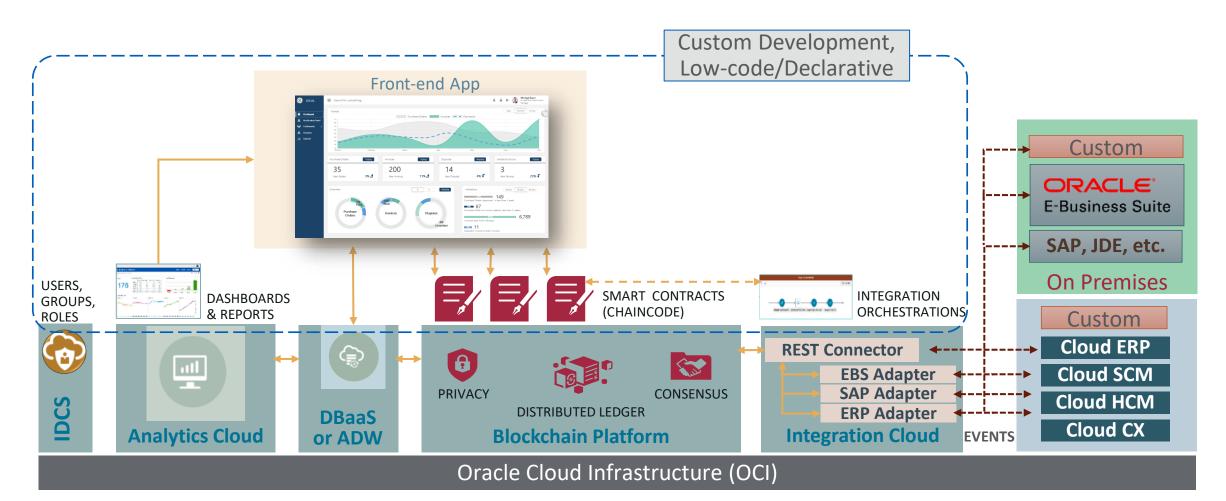
Fine-grained Access Control Lists capabilities



Architecture

Cloud Services Building Blocks

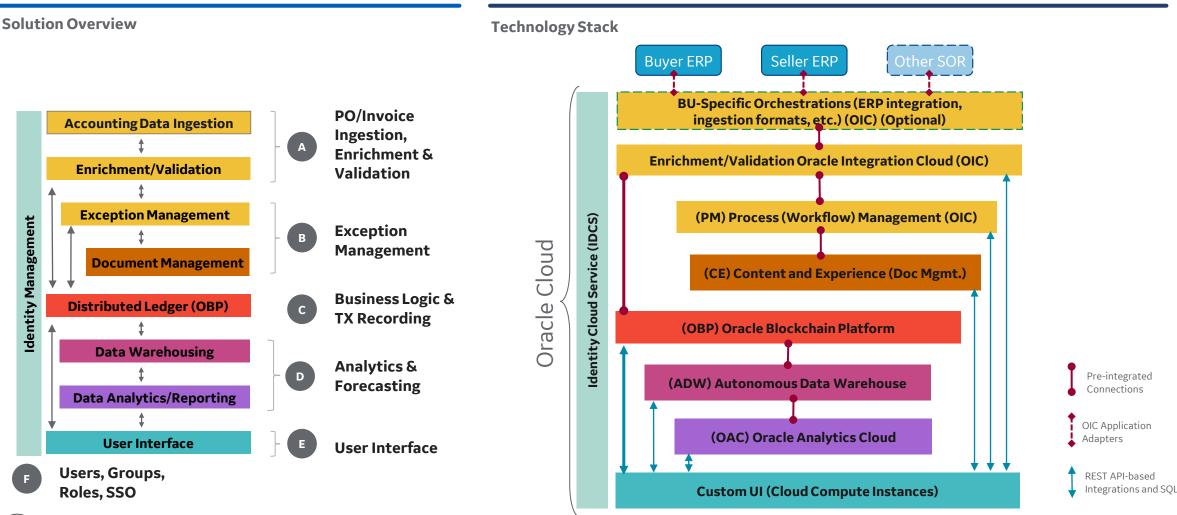
Pre-integrated Cloud Services for rapid development and managed operations





Solution & Integration with Oracle Products

Solution is built on a suite of Oracle Cloud platforms





Security: IDCS and Federation to Remote Identity Providers

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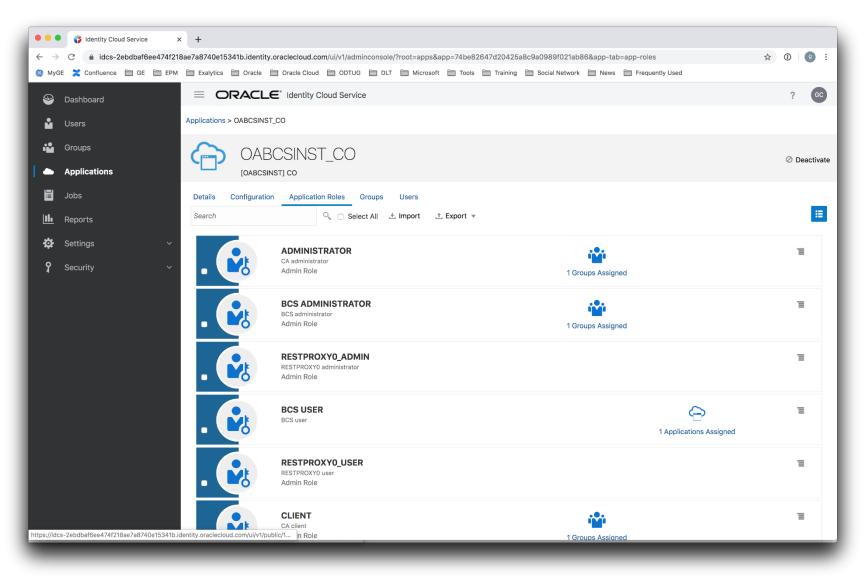
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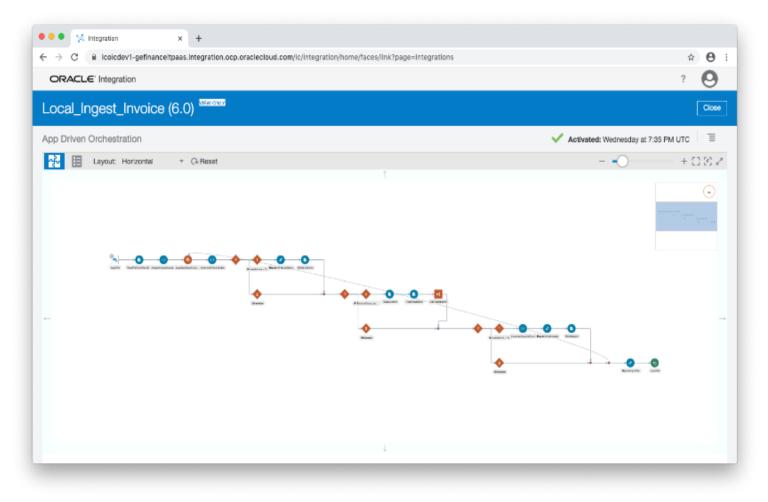
Security: Authentication and Authorization



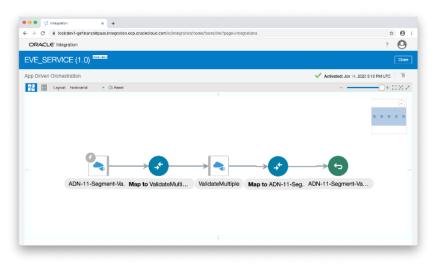


Data Integration

Reduces code development and provides off-the-shelf integration to existing systems



- Integration to break up CSV file into individual invoices and pass to the canonical invoice handling API
- Integration to take in invoice data, enrich the data, and submit to blockchain.
- EVE Validation
- DRM Enrichment
- Integration to process PO data and submit to blockchain





Oracle BaaS

Organization Nodes in the Blockchain Network

CO (Founder)		Ξ
Dashboard Network Nodes Channels Chaincodes Developer Tools		
Network Summary	As of February 16, 2020 9:07:57 AM UTC-00:00	a st
2 Participating Organizations		
Filter by Organization ID Role: All 🔹 🗮 🤤		
Organization Peer Orderer CA		



Oracle BaaS

Peer Nodes on Channels

	Console		Francisco.Ponce@ge.com 🔻
CO (Founder)			E
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Instantiated Chaincodes			
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Organizations	Blocks	User Transa	ctions
Channel Policies All	•		
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2712	April 2, 2020 3:43:01 PM UTC-00:00	data	1
2711	April 2, 2020 3:42:21 PM UTC-00:00	data	1
2710	March 23, 2020 2:49:15 PM UTC-00:00	data	1
2709	March 23, 2020 2:48:01 PM UTC-00:00	data	1
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Oracle BaaS

Rich History DB

ORACLE [®] Oracle Blockchain Platform Const	ole		Francisco.Ponce@ge.com 🔻
CO (Founder)			
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Up since September 5, 2019 4:32:42 AM UTC-00:00 Partition Utilization		Save	Top peers Endorsements Commits No peer activity
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Data warehouse

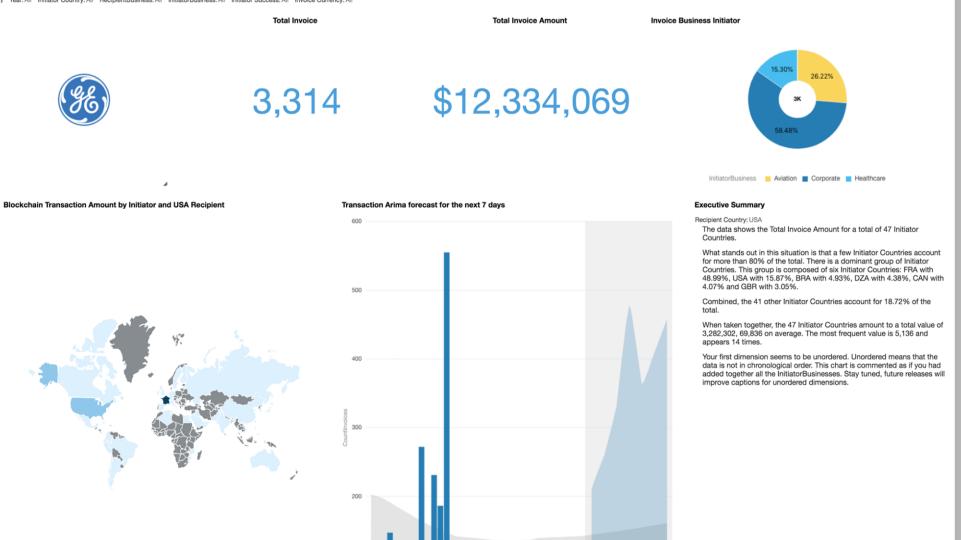
Rich History Database

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Analytics – Executive Summary

Executive

TY Year: All Initiator Country: All RecipientBusiness: All InitiatorBusiness: All Initiator Success: All Invoice Currency: All



Analytics – Transactional history

Transaction lifetime

T Source Invoice Number: All

1 Last Update Date (Second), Status Code Description, Source Invoice Number

Source Invoice Number: GUS1_V542_1-5 Remove Selection Remove Selection

📮 🔊 🔿 🦿 Present

GUS1_V542_1-5

01/22/2020 08:44:38 PM Status Code Description : Invoice has been settled

GUS1_V542_1-5

01/22/2020 08:44:38 PM Status Code Description : Invoice has been reconciled

GUS1_V542_1-5

1/19

01/22/2020 08:43:54 PM Status Code Description : Invoice has been updated from UI

GUS1_V542_1-5 01/13/2020 06:52:16 AM Status Code Description : EVE/DRM validation failed for invoice

1/12

Status Code Description 🗧 EVE/DRM validation failed for invoice 🔳 Invoice has been updated from UI 🔳 Invoice has been reconciled 🔳 Invoice has been settled

Analytics – Transaction provenance

Real-time

Year: All Initiator Country: All RecipientBusiness: All InitiatorBusiness: All Initiator Success: All Invoice Currency: All

Blockchain Real-time invoice transaction by status code



Current Month Summary

- Invoice has been updated from UI.
- EVE/DRM validation failed for invoice.

A single Status Code Description accounts for more than half of the total: Invoice has been settled, with 32.

Combined, the three other Status Code Descriptions make up the rest of the list, accounting for 28.89% of the total.

When taken together, the four Status Code Descriptions amount to a total value of 45, 11.25 on average.

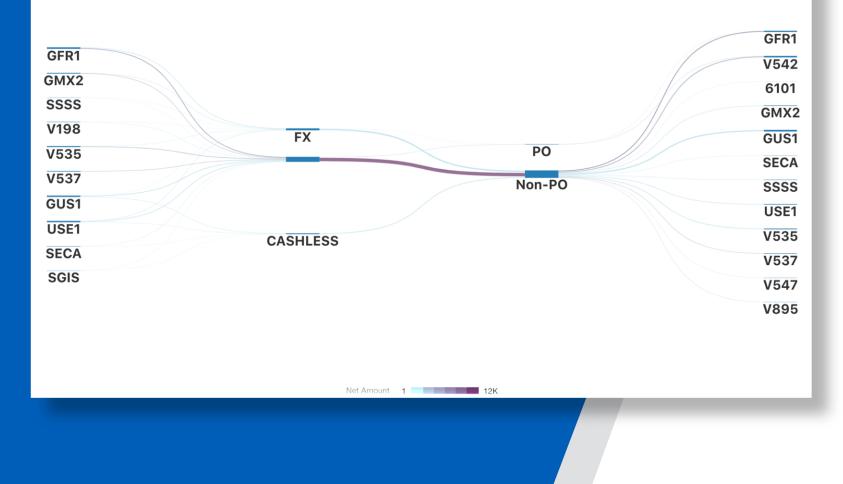
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GUS1_V542_1-5				NONPOCX0002				
01/13/2020 06:52:16 AM Status Code Desc					:09 AM Status Code De	scription : EVE/D	RM validation fa	iled for invo
GFR1 V542 1-13				NONPOCX0001		1 -	1	
01/13/2020 06:52:16 AM Status Code Desc		tion failed fo		01/19/2020 04:25:29 PM		n : Invoice has b	een reconciled	
AU00206			CX-0908					
01/13/2020 02:47:40 AM Status Code Descrip	tion : Invoice has been s	settled		07:39 AM Status Code Descri	ption : EVE/DRM validat	ion failed for invo	ice	
AU00206 01/13/2020 02:47:40 AM Status Code Descrip	tion : Invoice has been n	reconciled	CX-0907 01/18/2020 10	56:10 AM Status Code Descri		ion failed for invo	ice	
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CX_0111 01/12/2020 03:23:12 PM Status Code Description : Inv	roice has been settled	USE1_GFI 01/17/202		atus Code Description : Invoic		m UI		
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01/12/2020 03:23:12 PM Status Code Description : Inv	oice has been reconcile			A Status Code Description : Inv	oice has failed - 3way i	match		
						1		
AU00205 01/10/2020 11:43:52 PM Status Code Description : Invoice has been settled	GMX2_GFR1_3-25 01/16/2020.09:02	5 36 AM Stati	is Code Descripti	on : Invoice has been reconcil	ed 01/21/2020 03:13	39 PM Status C	de Description	Invoice ha
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AU00205	GMX2_GFR124				INVPOKC02			
01/10/2020 11:43:52 PM Status Code Description : Invoice has been reconciled	01/16/2020 09:02	:36 AM State	is Code Descripti	on : Invoice has been reconcile	ed 01/21/2020 03:13	:31 PM Status Co	de Description :	Invoice ha
AU00204	GMX2_GFR124				INVPOCX0047	1	1	1
01/10/2020 11:33:57 PM Status Code Description : Invoice has been settled	01/16/2020 08:56	31 AM Statu	s Code Descripti	on : Invoice has been reconcile		45 PM Status Co	de Description :	Invoice ha
	Y					1		
AU00204 01/10/2020 11:33:57 PM Status Code Description : Invoice has been reconciled	GMX2_GFR1_3-25 01/16/2020 08:56		is Code Descripti	on : Invoice has been reconcil	INVPOKC02 01/21/2020 03:13	31 PM Status Co	de Description :	Invoice ha
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CA_INV_13 10/2020 01:53:02 PM Status Code Description : EVE/DRM validation failed for invoic	e GMX2_GFR1_1-23 01/16/2020 08:56		us Code Descripti	on : Invoice has been settled	CX-0857 01/21/2020 09:45:54	AM Status Code	Description : In	voice has b
CA_INV_12 10/2020 01:51:55 PM Status Code Description : EVE/DRM validation failed for invoic	e GMX2_GFR1_1-23 01/16/2020 08:56		is Code Descripti	on : Invoice has been reconcil	INVPOKC01 01/21/2020 03:13	15 PM Status Co	de Description :	Invoice ha
CA_INV_12 10/2020 01:33:18 PM Status Code Description : EVE/DRM validation failed for invoic	GMX2_GFR1_1-23		code Descripti	on : Invoice has been reconcile	INVPOKC01 01/21/2020 03:13	TE DM Status Co	de Description	Invoice ha
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CA INV 12	GMX2_GFR1_3-26				INVPOCX0052B			-
10/2020 01:32:12 PM Status Code Description : EVE/DRM validation failed for invoice	01/16/2020 08:47:	58 AM Statu	is Code Descripti	on : Invoice has been reconcile		1:12 PM Status Co	de Description :	: Invoice ha
CA.INV.12	GMX2_GFR124				INVPOCX0052A			
10/2020 01:28:35 PM Status Code Description : EVE/DRM validation failed for invoic		58 AM Statu	s Code Descripti	on : Invoice has been reconcile		52 PM Status Co	de Description :	: Invoice ha
CA_INV_12 10/2020 01:27:01 PM Status Code Description : EVE/DRM validation failed for invoice	GFR1_GMX2_4-26 01/16/2020 08:47:		is Code Descripti	on : Invoice has been settled	CX-0855 01/21/2020 09:38:37	AM Status Code	Description : Inv	voice has b
							643	
CA_INV_12 10/2020 01:26:34 PM Status Code Description : EVE/DRM validation failed for invoic	e GFR1_GMX2_4-26 01/16/2020 08:47:		is Code Descripti	on : Invoice has been reconcile	ed 01/21/2020 02:47	52 PM Status Co	de Description	: Invoice ha
	MIL							
CA_INV_12 10/2020 01:03:28 PM Status Code Description : EVE/DRM validation failed for invoic:	e 01/16/2020 08:44:	54 AM State	s Code Descripti	on : Invoice has been updated	from UI			
CA_INV_12	AU00206							
10/2020 01:01:43 PM Status Code Description : EVE/DRM validation failed for invoice	01/16/2020 08:44	51 AM Statu	s Code Description	on : Invoice has been updated	from UI			

Status Code Description
EVE/DRM validation failed for invoice
Invoice has been settled
Invoice has been reconciled
Invoice has been updated from

Invoice has been settled
 Invoice has failed - 3way match
 Invoice has been updated from UI
 Invoice has failed - 2way match

Analytics

Initiator Company Code, Settlement Type, Invoice Type, Recipient Company Code, Net Amount Initiator Company Code: GFR1, GMX2, GUS1, SECA, SGIS, SSSS, USE1, V198... +2



- Distribution of invoices by
 Company Code initiator and
 Company Code recipient
- Distribution of invoices by type of payment

Using Blockchain to manage Intercompany invoices

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				Initiator Company	Code Recipient Company Code	Total Invoice Amount	Invoice Currency		Aging
		PO Number		Initiator Company	Code Recipient Company Code	Total Invoice Amount	Invoice Currency		
	Invoice Number	PO Number	Invoice Date					Invoice Transaction Status Code	Aging
	Invoice Number	PO Number	Invoice Date	GMX2	GFR1	803.00	MXN	Invoice Transaction Status Code	Aging
	Invoice Number NH12-GMX2_GFR1-8 NH12-V895_V542-9	PO Number - -	Invoice Date Dec-20-2019 Dec-20-2019	GMX2 V895	GFR1 V542	803.00 506.00	MXN GBP	Invoice Transaction Status Code Closed Closed	Aging 148 148
	Invoice Number NH12-GMV2_GFR1-8 NH12-V895_V542-9 KC_TLG8_SSS	PO Number - - -	Invoice Date Dec-20-2019 Dec-20-2019 Jan-23-2020	GMX2 V895 TLGB	GFR1 V342 SSSS	803.00 506.00 151,515.00	MXN GBP INR	Invoice Transaction Status Code Closed Closed Hold	Aging 148 148 114
	Invoice Number NH12-GMX2_GFR1-6 NH12-V895_V542-9 KC_TLG8_SSS NH12-GFR1_V542-10	PO Number - - -	Invoice Date Dec-20-2019 Dec-20-2019 Jan-23-2020 Dec-20-2019	GMX2 V895 TLGB GFR1	GFR1 V542 SSSS V542	803.00 506.00 151,515.00 1.102.00	MXN GBP INR EUR	Invoice Transaction Status Code Closed Closed Hold Closed	Aging 148 148 114 148
	Invoice Number NH12-GMV2_GFR1-8 NH12-VB95_V542-9 KC_TLG8_SSS NH12-GFR1_V542-10 NH12-GFR1_V542-10	PO Number - - -	Invoice Date Dec-20-2019 Dec-20-2019 Jan-23-2020 Dec-20-2019 Dec-20-2019 Dec-20-2019	GMX2 V895 TLG8 GFR1	GFR1 V542 SSSS V542 V542 V542	803.00 506.00 151,515.00 1.102.00 1.102.00	MXN GBP INR EUR EUR	Invoice Transaction Status Code Closed Closed Hold Closed Closed	Aging 148 148 114 148 148 148 148

Architecture Summary

iDeAL solution is built on a collection of pre-integrated cloud platform services

- Integration, Blockchain, Data warehouse, Analytics, Identity management
 - Each strong, but providing greater value when used together
 - Enables rapid development of complex applications using well-defined APIs
 - Supports declarative/low-code development of many components
 - Provides independent layers of Microservices-based functionality
- Enables IT Flexibility and Business Agility
 - Decentralized topology and flexible deployment architecture for corporate and BU needs, speeds up execution of TSAs
 - Provides high availability and resilience of managed cloud services in a cost-effective manner
 - Can easily evolve through ability to add additional BUs and ERPs, validations/enrichments, process flows (disputes, holds, etc.), smart contracts, dashboards, and downstream integrations.







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