

# Healthcare Data Interoperability



February 2023



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ex-FHIR – Guiding Principles, Unique Capabilities

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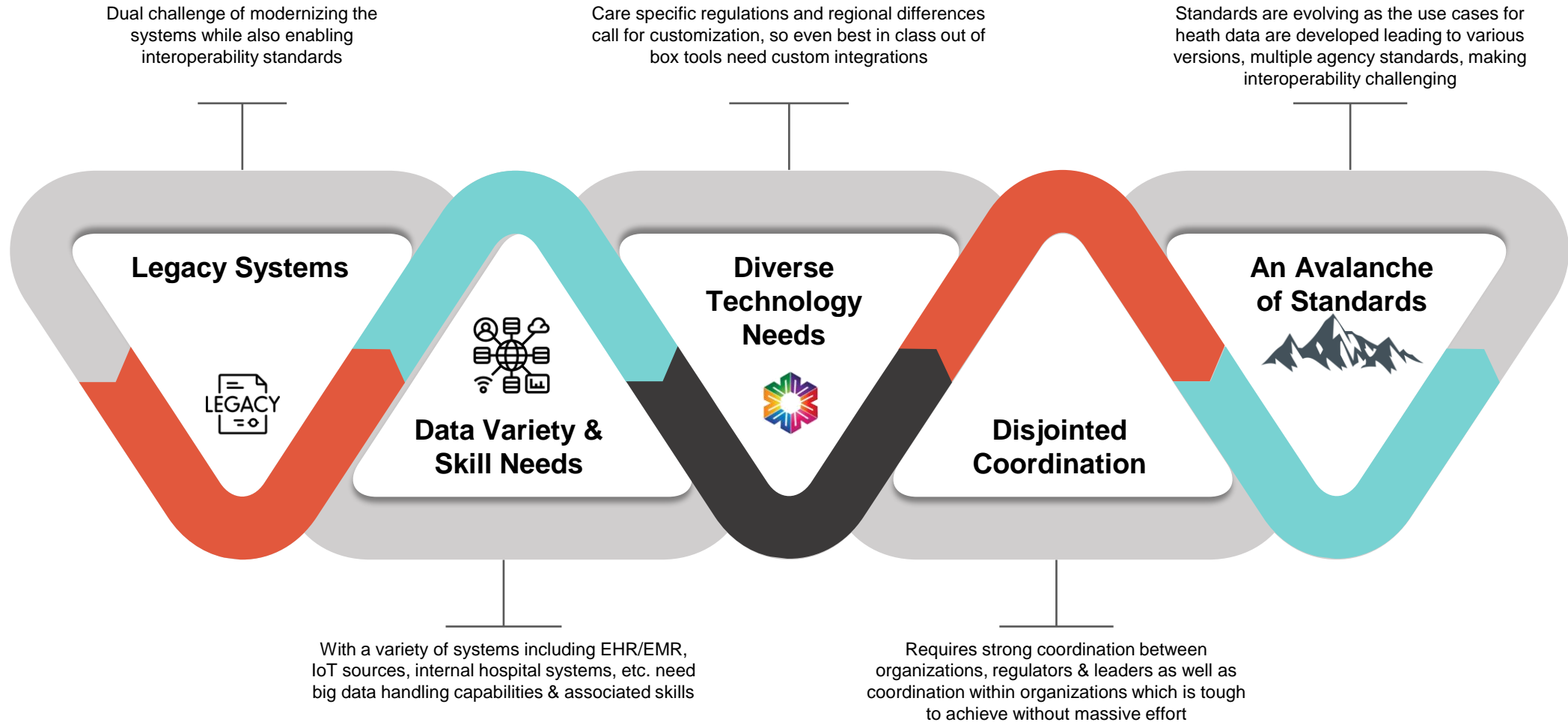
# Why Interoperability

“Interoperability helps clinicians deliver safe, effective, patient-centered care. It also provides new ways for individuals and caregivers to access electronic health information to manage and coordinate care”.

“Advancing interoperability is now an essential part of most health care activities ranging from health equity to public health emergency response”

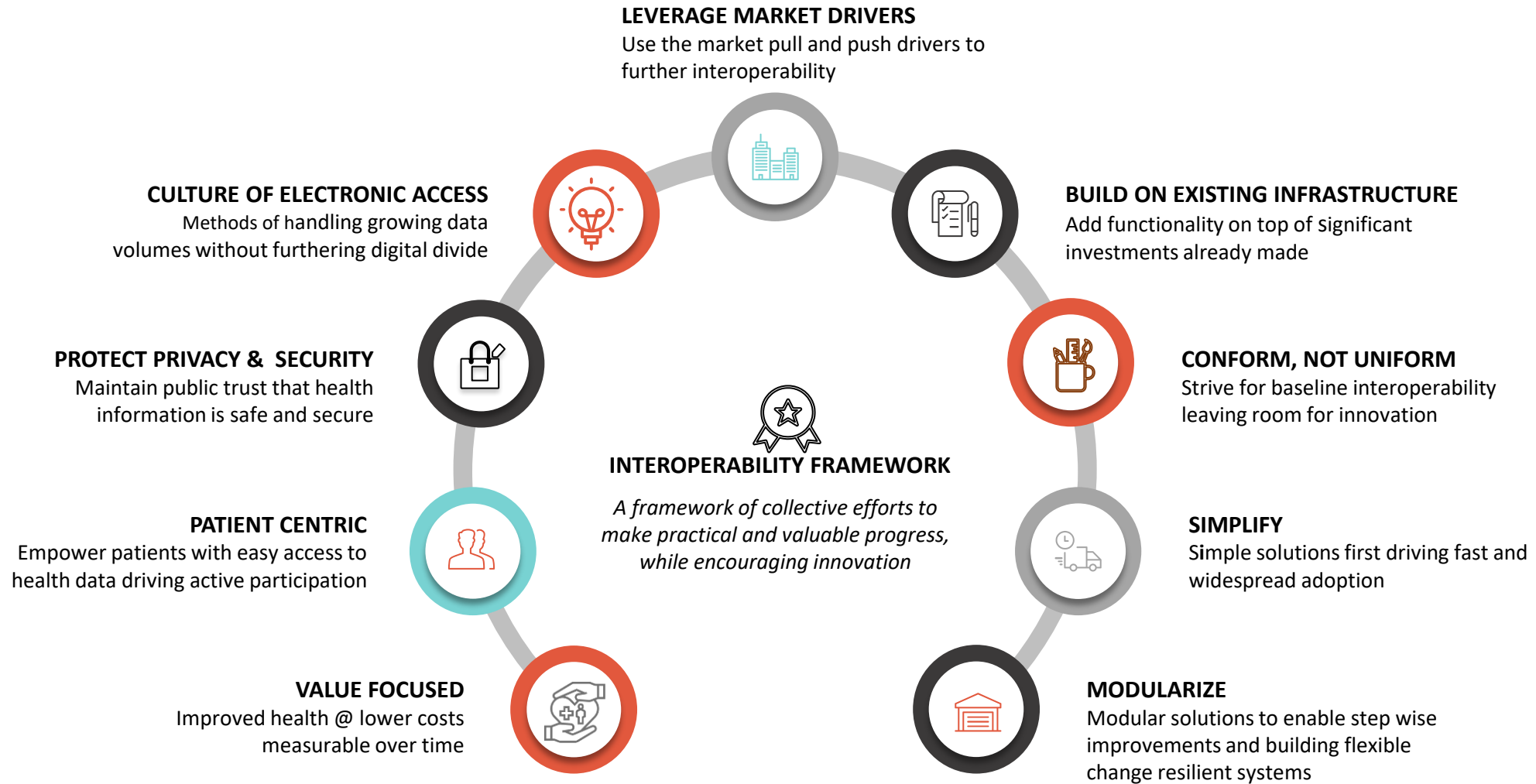
-Official Website of The Office of the National Coordinator for Health Information Technology (ONC)

# But Implementing Interoperability is challenging because...



# Exf-FHIR: Platform to Operationalize Healthcare Data Interoperability

# Based on ONC's Interoperability Guiding Principles



# Exf-FHIR Solution – Key Features

## CURRENT SITUATION

Healthcare Data Interoperability is messy!



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"We're still working out a few bugs in our new EMR system. Are you the 72 year old with gall stones, or are you the one that's here for breast enhancement?"

*If Big Data is the new oil in healthcare, clinical & business intelligence is the refinery*

*Brendan FitzGerald, Healthcare IT News*

## EXAFUENCE SOLUTION

Exf-FHIR:

Data Standardization & Harmonization

### Exf-FHIR Features



Multi-source  
Data Ingestion



GUI based  
Mapping



Scalable  
Processing



Batch Data  
(Spark)



Streaming  
Data (Kafka)



Workflow  
Management



Data Formats  
& Variety



Custom  
Extensions



Custom  
Profiles



Patient  
Portal



Secure REST  
APIs

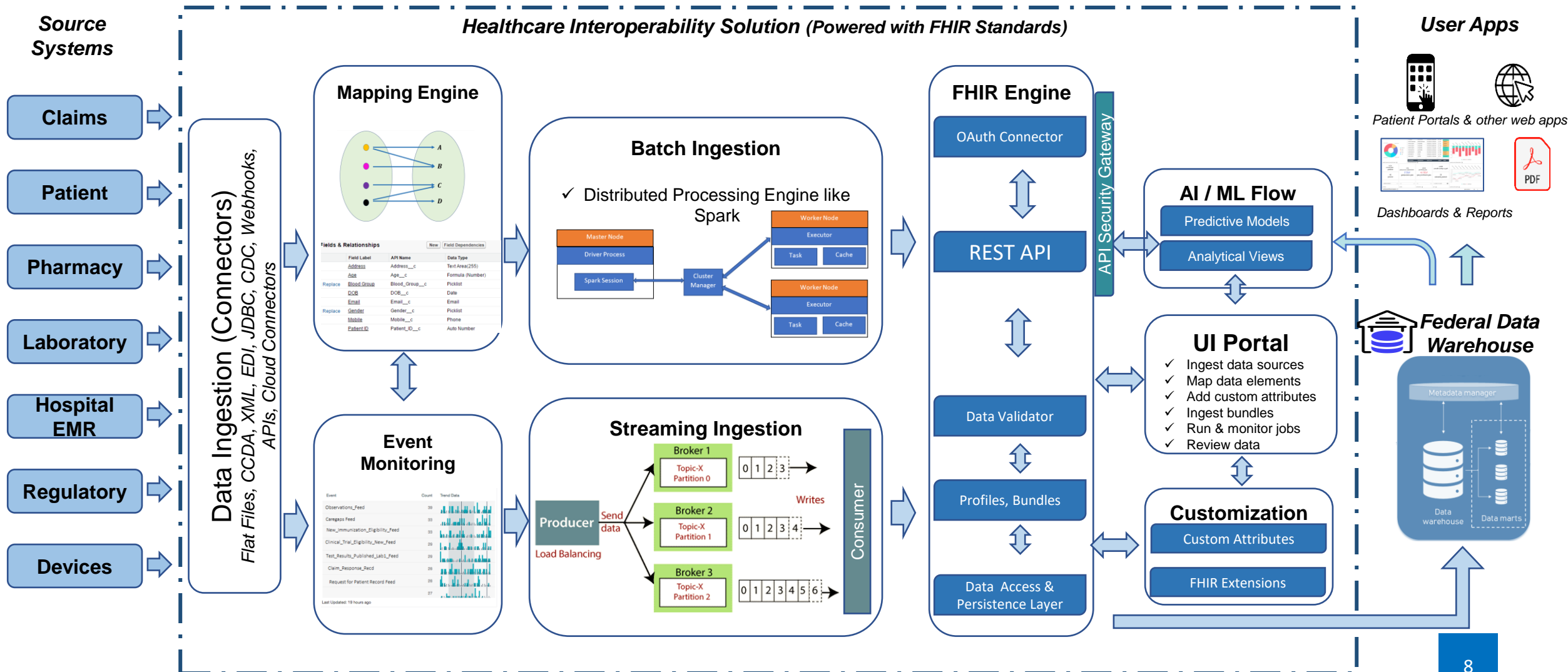


Authenticate  
& Authorize

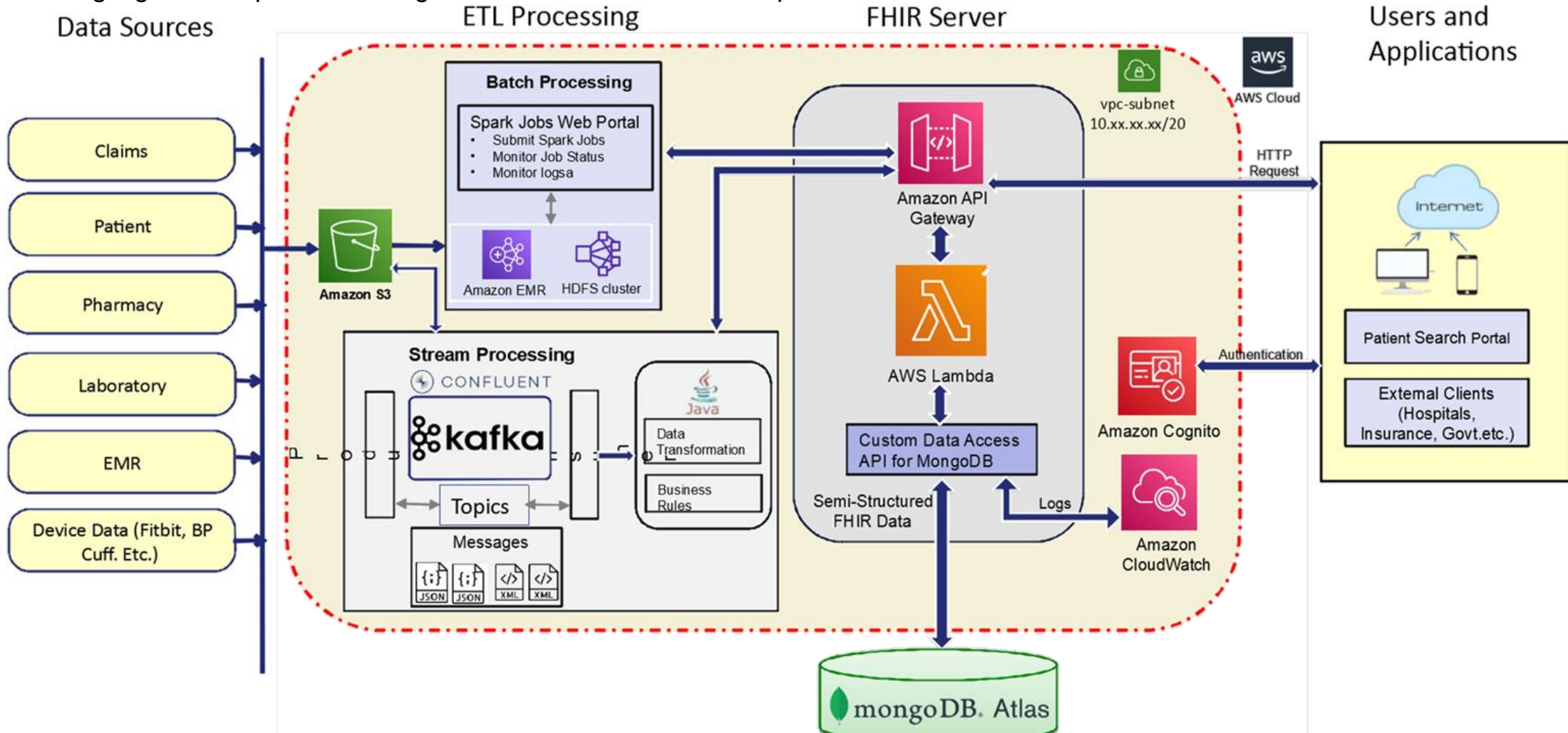
# Exafluence Interoperability Solution – Architecture

Exafluence's FHIR solution is a business-friendly platform with custom extensions, profiles, cloud agnostic, database agnostic, modular, secure, rapidly deployable solution.

Our federal solution brings the above-mentioned capabilities along with ability to push data to data warehouses of the agency's choice



Exaflunce enhanced AWS FHIR solution (FHIRWorks) to use a lower cost, document data model-based DB, enabled easy batch and streaming ingestion capabilities using the exf-FHIR's UI interface, spark and kafka modules.



S.No	Components	Technology
1	Persistence Layer	Java, Maven Packages, SpringBoot
2	FHIRWorks Database	MongoDB Atlas
3	Frontend Portal / User Interface	React JS
4	Batch Ingestion Module	Apache Spark, Amazon EMR, Java
5	Authentication & Authorization	Java, Cognito, Amazon API Gateway
6	Streaming Ingestion & Bundle Ingestion	Apache Kafka, My SQL
7	Single Click Solution Deployment	Docker, Cloud Formation Templates / Docker Compose

# Exf-FHIR: Solution Snapshots

# Exafluence Interoperability Solution – Data Loading

The screenshot shows a web application interface for data loading. At the top left is the 'ConnectMed' logo. At the top right, the user 'jeevan' is logged in with a 'Sign out' button. A navigation bar contains the following links: 'Patient Information', 'Add Custom Attributes', 'Map Non-FHIR to FHIR data' (which is underlined and active), 'Load FHIR JSON Bundles', and 'Data Load Status'. The main content area is titled 'Map Non-FHIR to FHIR Data'. On the left side of this area, there is a form with two sections: 'Datasource Name' with a dropdown menu currently showing 'PatientCSV', and 'Data Format' with a search input field. Below the search field is a list of data format options: 'File System', 'CCDA', 'CSV', 'EDI', 'API', 'CMS Benefits API', 'CMS BlueButton API', and 'VA Patient Health API'. The 'CCDA' option is currently selected. To the right of the form is a large, empty rectangular box with a green border. At the bottom right of the page, there is a copyright notice: '© Copyright 2023'.

# Exafluence Interoperability Solution – Data Loading

The screenshot displays the 'Map Non-FHIR to FHIR Data' interface. On the left sidebar, the 'Datasource Name' is set to 'PatientCSV', the 'Data Format' is 'CCDA', and the 'Source' is 'C-CDA\_R2-1\_CCD.xml'. A 'Post to FHIR Server' button is visible. The main area shows the resulting FHIR JSON bundle:

```
{
  "entry": [
    {
      "resource": {
        "date": "2013-08-15T10:30:00-08:00",
        "identifier": {
          "system": "urn:oid:2.16.840.1.113883.19.5.99999.1",
          "use": "official",
          "value": "TT988"
        },
        "custodian": {
          "reference": "Organization/c5efe53e-683a-4a64-a703-9be1ae8414b3",
          "display": "Good Health HIE"
        },
        "subject": {
          "reference": "Patient/d07a27a7-be19-408b-ac39-4d9644bfa2b5",
          "display": "Eve Betterhalf"
        },
        "author": [
          {
            "reference": "Practitioner/0bb1f70-b7dd-47df-b0a4-f1de998090cf",
            "display": "Patricia Patty Primary M.D."
          }
        ],
        "confidentiality": "N",
        "type": {
          "coding": [
            {
              "system": "http://loinc.org",
```

# Exafluence Interoperability Solution – Data Loading



jeevan Sign out

Patient Information Add Custom Attributes Map Non-FHIR to FHIR data Load FHIR JSON Bundles Data Load Status

Job Details

Export to CSV

SparkJobID	Submitted Time	ClusterID	Metadata	Resource Type	Status	Action
6g0a1b6g	1/17/2023 5:31:21 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
1b3d4e7h	1/17/2023 5:48:26 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
2c7h2c1b	1/17/2023 5:52:11 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Submitting	
9j2c5f3d	1/17/2023 5:53:44 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
9j4e1b3d	1/17/2023 6:05:29 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
8i3d0a7h	1/17/2023 6:08:51 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
6g0a5f8i	1/17/2023 6:19:41 PM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Running	
4e1b0a4e	1/17/2023 8:04:38 PM	cluster-0000	<a href="#">Mapping Details</a>	Encounter	Completed	
5f0a5f5f	1/18/2023 10:27:22 AM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Completed	
3d7h2c6g	1/18/2023 10:35:46 AM	cluster-0000	<a href="#">Mapping Details</a>	Patient	Completed	

< 1 2 3 >

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# Exafluence Interoperability Solution – Custom Attributes



jeevan Sign out

Patient Information Add Custom Attributes Map Non-FHIR to FHIR data Load FHIR JSON Bundles Data Load Status

## Add Custom Attributes

Last Edited by : ( Invalid Date Invalid Date )

### Resource Type

Patient

Reset

<input checked="" type="checkbox"/> telecom	humanname	<input type="checkbox"/> spouseName	string
<input checked="" type="checkbox"/> gender	ContactPoint	<input checked="" type="checkbox"/> SpouseMaidenName	string
<input checked="" type="checkbox"/> birthDate	code	<input checked="" type="checkbox"/> codeableOccup	CodeableConcept
<input checked="" type="checkbox"/> deceasedBoolean	date	<input checked="" type="checkbox"/> lat	string
<input checked="" type="checkbox"/> deceasedDateTime	boolean	<input checked="" type="checkbox"/> long	string
<input checked="" type="checkbox"/> address	dateTime	<input checked="" type="checkbox"/> RiskScore	integer
<input checked="" type="checkbox"/> maritalStatus	Address	<input checked="" type="checkbox"/> GenderAll	string
<input checked="" type="checkbox"/> multipleBirthBoolean	CodeableConcept	<input checked="" type="checkbox"/> trials	code
<input checked="" type="checkbox"/> multipleBirthInteger	boolean		
<input checked="" type="checkbox"/> photo	integer		
	Attachment		

CustomField1 String

+ Add Field Save Submit

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# Exafluence Interoperability Solution – Patient Portal



jeevan Sign out

Patient Information Add Custom Attributes Map Non-FHIR to FHIR data Load FHIR JSON Bundles Data Load Status

name gender city [Search] [Refresh]

Mr. Aaron697 Brekke496	GENDER Male DOB 10/11/1945 PHONE -- ID 5cbc121b-cd71-4428...	Mr. Aaron697 Stiedemann542	GENDER Male DOB 5/2/1948 PHONE -- ID adccf2c3-9dc4-4067...	Abby752 Kuvalis369	GENDER Female DOB 12/9/2003 PHONE -- ID 31191928-6acb-4d73...
Mrs. Barabara924 Lockman863	GENDER Female DOB 4/6/1921 PHONE -- ID 57ca2c16-7008-41e5...	Ms. Barbara209 Delgado712	GENDER Female DOB 3/9/1974 PHONE -- ID 4dbee22d-0aba-4432...	Mr. Barney639 McCullough561	GENDER Male DOB 5/2/1948 PHONE -- ID b4be702f-d857-45d1...
Mr. Cameron381 Beatty507	GENDER Male DOB 10/7/1954 PHONE -- ID 2212d4e0-5794-4821...	Mr. Cameron381 Hamill307	GENDER Male DOB 4/11/1959 PHONE -- ID 3e35904e-5dc7-4324...	Cameron381 Kiehn525	GENDER Male DOB 2/4/2006 PHONE -- ID d60e619e-3308-47a5...

# Exafluence Interoperability Solution – Patient Portal

The screenshot displays a patient portal interface. At the top left is the 'ConnectMed' logo. At the top right, the user 'jeevan' is logged in with a 'Sign out' button. Below the header is a navigation bar with links: 'Patient Information' (underlined), 'Add Custom Attributes', 'Map Non-FHIR to FHIR data', 'Load FHIR JSON Bundles', and 'Data Load Status'. The main content area is titled 'Patient info' and features a sidebar on the left with a list of menu items: Patient, Observation, CarePlan, Immunization, Practitioner, Organization, Condition, Claim, Encounter, Medication Request, Diagnostic Report, and Goal. The 'Patient' menu item is selected. The main content area shows a patient profile for 'Mr. Aaron697 Brekke496' with a 'Patient' title and navigation buttons for 'Previous' and 'Next'. Below the profile is a table with the following data:

Identifier	Name	Gender	Birth Date	Address	City	ZIP Code	Phone
5cbc121b-cd71-4428-b8b7-31e53eba8184	Mr. Aaron697 Brekke496	male	10/11/1945	894 Brakus Bypass	Taunton		

At the bottom right of the table, there is a pagination control showing '< 1 >'. The footer of the page contains the copyright notice '© Copyright 2023'.

# Exafluence Interoperability Solution – Patient Portal



jeevan Sign out

[Patient Information](#) [Add Custom Attributes](#) [Map Non-FHIR to FHIR data](#) [Load FHIR JSON Bundles](#) [Data Load Status](#)

## Patient info



Mr. Aaron697 Brekke496

« Previous Next »

### Claim

Type	BillablePeriod	Priority	Status	ValueQuantity	Created
institutional	from 11/15/1965 to 11/15/1965	normal	active		11/15/1965
institutional	from 2/21/1977 to 2/21/1977	normal	active		2/21/1977
institutional	from 12/21/1987 to 12/21/1987	normal	active		12/21/1987
institutional	from 3/1/2010 to 3/1/2010	normal	active		3/1/2010
institutional	from 12/7/2010 to 12/7/2010	normal	active		12/7/2010
institutional	from 3/7/2011 to 3/7/2011	normal	active		3/7/2011
institutional	from 11/3/2011 to 11/3/2011	normal	active		11/3/2011
institutional	from 3/12/2012 to 3/12/2012	normal	active		3/12/2012
institutional	from 3/31/2012 to 3/31/2012	normal	active		3/31/2012
institutional	from 1/18/2013 to 1/18/2013	normal	active		1/18/2013

< 1 2 3 4 5 6 7 > 10 / page v

- Patient
- Observation
- CarePlan
- Immunization
- Practitioner
- Organization
- Condition
- Claim**
- Encounter
- Medication Request
- Diagnostic Report
- Goal

# Exf-FHIR: Market Comparison

# FHIR Solutions - Comparison

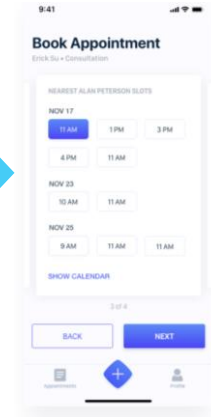
Aspect	exf-FHIR	Global Cloud Services Provider	Top EHR Vendor	Search Giant & Tech Major	Focused Health IT Start-Up	European FHIR Provider
Custom Profiles & Extension	★★★★★	★★	★★★	★★★	★★★★	★★★★
EMPI (Patient Indexing)	★★★★★	★★★	★★★	★★★	★★★★★	★★★
DE with Custom Components	★★★★★	★★	★	★★	★	★★
Federal Centric API enablement	★★★★★	★★★	★★	★★★	★★★★	★★★★
HAPI FHIR Compliance	★★★★★	★★	★★	★★	★★★	★★
Streaming Connectors, IoT data	★★★★	★★★	★★★	★★	★★★★	★★★
Value / Use Cases	★★★★	★★	★★★★★	★★	★★★★	★★★
Data Exchange	★	★★	★★★★	★	★★★★	★
App Ecosystem	★★	★★★	★★★	★★	★★★★	★★
Mobile Integrations	★★★	★★★	★★★★★	★★★★	★★★★	★★★
BI Integrations	★★★★	★★	★★★★	★★★★	★★★	★★★
RDBMS Connectivity	★★★★★	★★★	★★★★★	★★★★★	★★★★	★★★

# Exf-FHIR: Select Client Deployments

# Select Client Implementations

## European MNC focusing on eyewear and lenses

Leveraging pre-built FHIR accelerator components deployed FHIR solution in 2 weeks. This FHIR platform powers the appointment system across multiple geographies



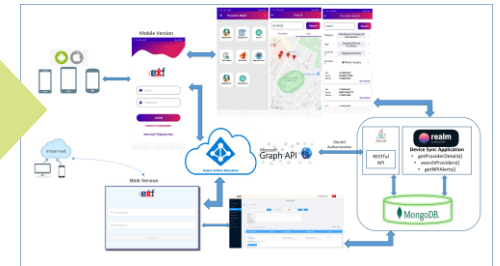
## NY based Medical Device Manufacturer Startup

Developed the real-time mobile and web applications for continuous monitoring of vitals like EKG, Temperature, HRV, posture, skin temperature etc., with active alerts to care providers, doctors etc.. Enabled FHIR based clinical data integrations for effective decision making



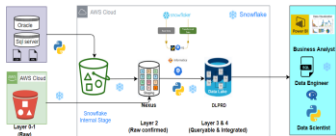
## NY based Pension Fund & Accountable Care Organization

Deployed and integrated a FHIR system that ingests multiple data sources including CCDAs, XML, FHIR bundles & Flat files which powers multiple member engagement mobile apps, a provider MDM & credentialing solution



## NY based - Home Health Care Services Company

Modernized their infrastructure resulting in cost savings of over 40% and enabled FHIR regulatory compliance





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**THANKYOU**