

Connect Health/iDAAS (Intelligent Data as a Service) Platform

By:
Alan Scott
Chief Architect, Healthcare

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Overview

There are many forces from a competitive, legislative or reimbursement perspective that are applying pressure across the entire healthcare vertical space. Over the last decade these forces have continued to both grow and morph. Some of the external forces include technical demonstration of value, state and federal mandates continuing to expand, competitors that are also partners, third party business leveraging various aspects of both clinical and financial data, financial pressures from areas such as reimbursement levels dropping while requirements around care continue to increase and areas like value based care continuing to expand. With all these forces the one thing healthcare and all the constituents of healthcare see as their main means to address these forces is their data. Because of the extensive amount of data involved within the healthcare organizations they continue to procure or are transforming to develop and deliver solutions. Irrespective of their business model: buy, build or buy/build the key to healthcare's effectiveness is better and more accurate access to information in near real-time that can give them intelligence and enable them to have better integration capabilities in near real time.

Most healthcare organizations leverage messaging oriented middleware style integration, send all data to all systems with little or no intelligence, governance or data management. Most vendors providing solutions are typically focused around providing solutions that ONLY deals with a small subset of very specific information based on their technical requirements. This integration practice puts organizations in a potential data breach situation. Also, the majority of vendors providing solutions have home grown and/or custom developed technologies to support their data needs. How can Red Hat help address the challenges? Red Hat's healthcare team has designed a platform, iDAAS

(Intelligent Data as a Service); hereafter, iDAAS. It is intended to help drive value by being an extensible platform that is focused around various healthcare industry needs while providing very broad capabilities. iDAAS is a hybrid cloud based platform with many capabilities and features.

Here are some of the capabilities:

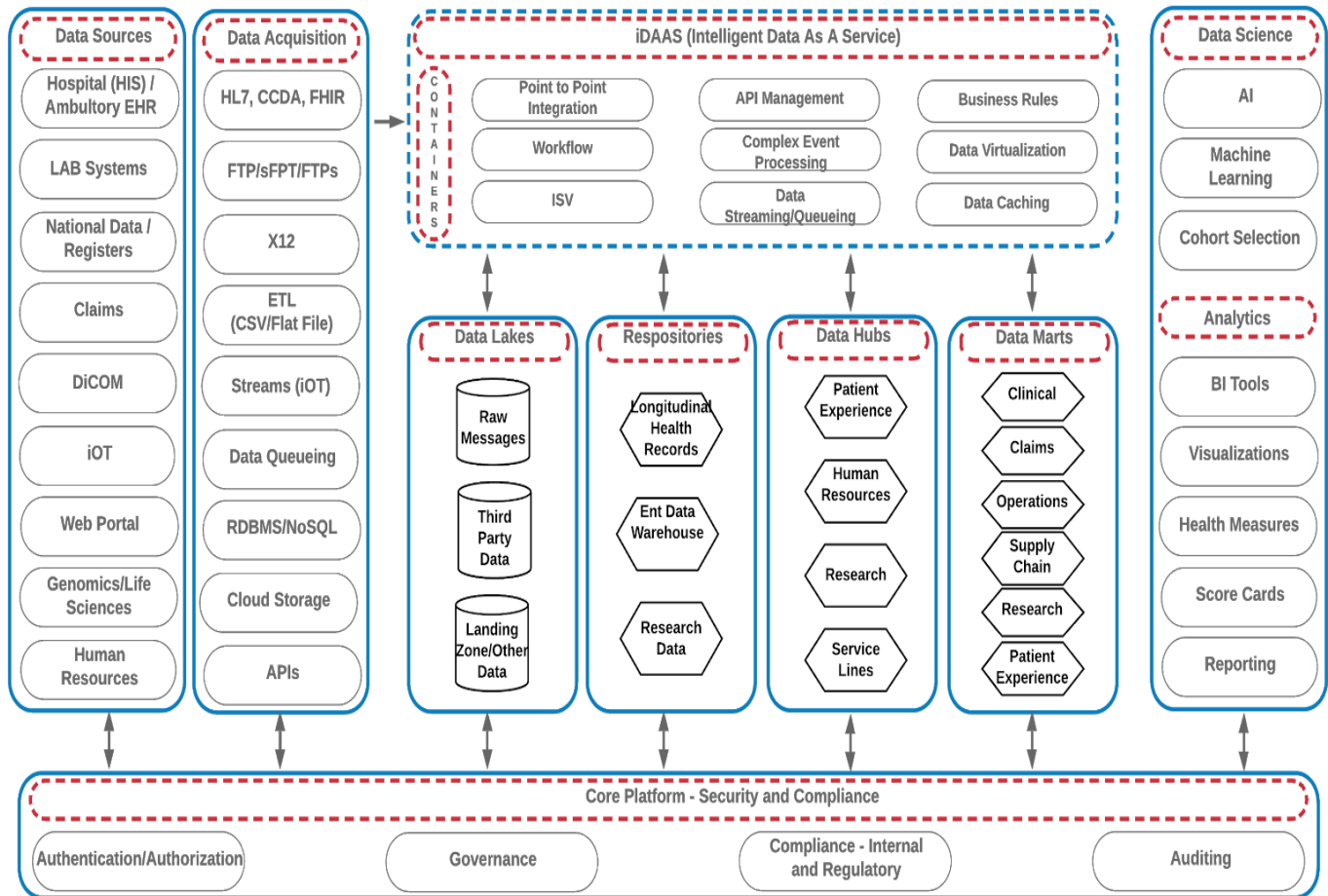
- **Receive:** receive data from various formats. We have branded this capability iDAAS Connect. From receiving data we focus on industry standards and then third party connectivity. Industry standards support include HL7 v2, FHIR, and EDI Claims. There are potential future plans for NCPDP and HL7 v3 message support being discussed.
- **Route:** enable data to be routed to many sources. For this capability we have focused on building out several specific components such as healthcare event builder (both code and integration), intelligent data router.
- **Resolve:** Enable error handling and insight to resolve potential processing issues. Also, the need to replay messages for new needs.
- **Research:** Enable access to information in a reusable auditable manner.

Here are just a few of the core features of the platform:

- Modularly based platform, designed to ensure capabilities are met and extensible for future needs.
- Capable of processing industry standard healthcare data - Support for protocol connectivity options like File, APIs, Queuing, FTP(S) or SFTP and HL7.
- Built for scalability - Where possible, the platform is cloud native in every aspect.

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- Extensibility – platform enables integration to be event based versus message based, enables and leverages business rules, business process management, complex event processing, APIs, queuing/streaming, data virtualization.
 - Polyglot language support – the platform is cloud native. In order to enable the broader development community there are several programming languages used. What we have done to simplify everything is ensure we use a programming language per area of the platform.
 - Community source focused – The source code is available for any modular component including DDLs for anything data related.
 - Innovation based – download the code, any of the specific repositories, and leverage for your needs with the complete ability to extend as needed.

Since iDAAS is a swiss army knife of capabilities that is intended to cover base needed capabilities and enable the implementer to extend it based on their specific needs of capabilities they wanted to enable. With all the potential ways we could demonstrate capabilities of this platform we want to ensure the demonstrations will address key components that we deliver as base offerings. These base offerings are covered in the vertical based use cases and scenarios. We also want to ensure that other Red Hat resources and industry resources (SI, partners and customers) can have access to these demos as they are stood up and enhanced over time. It is a market differentiator and also showcases a huge part of the Red Hat culture, the open source difference. The image below is meant to visualize the specific healthcare industry and the various ways it works with data.



Background - Industry Standards

HL7

HL7 is one of the standards bodies that manages specifications in healthcare, their focus is the clinical care side of the industry and they only handle specific billing related transactions as part of supporting the clinical services they support. For more details on all the specifications they manage in

healthcare, please feel to visit [HL7 Web Site](#). HL7 is a very legacy based standards specific to the way communications occur. The HL7 v2 message standard has been a long standard for the clinical industry and vendor platforms to communicate for decades. It is often known as quasi standard throughout the healthcare industry due to its lack of hard and fast rules and openness for vendor augmentation. It has evolved from version 2.1 to its most current version 2.8 and is still being very actively enhanced. HL7 v2 communication involves a client-server based communication model known as MLLP (Minimal Lower Layer Protocol), the expectation is that the server is running one hundred percent of the time to receive transactions. As part of its communication it requires that every transaction is specifically acknowledged or negatively acknowledged during processing. Finally, healthcare systems and integrations typically involve a FIFO based messaging pattern, every message must be processed in order.

The iDAAS Platform has been tested and has the following HL7 v2 support.

HL7 Transaction Types	HL7 Version Support	Total Message Types Supported
ADT (Admissions, Discharges, Transfers) - A01 to A61	Any v2 message version release	60
ORM (Orders)	Any v2 message version release	4
ORU (Results)	Any v2 message version release	4
MDM (Master Data Management)	Any v2 message version release	5
MFN (Master File Notifications)	Any v2 message version release	5
SIU (Schedule)	Any v2 message version release	15

VXU (Vaccinations)	Any v2 message version release	1
Total Message Support		95

FHIR

HL7 FHIR is the healthcare industry standardization approach to modernizing its messaging standards and capabilities. This focus has been geared away from the HL7 server client connectivity model and focused on a REST API based connectivity model. Unlike other attempts to modernize standards this one has been around for several years and has a very large community supporting it. Based on the adoption and numerous CMS guidelines pushing it forward this will be the go forward integration standard. From a simplification perspective there simplified the message type process to a module based approach and there are five key modules - clinical, diagnostic, medications, workflow and financials. Here is the latest version of [FHIR](#), please feel free to look.

The iDAAS Platform is working on incorporating and testing all the following HL7 FHIR support. We have decided to focus on where CMS has defined as the standard for [Interoperability and Patient Access](#) final rule. This includes comprehensive FHIR transaction processing requirements including detailed parsing capabilities for growth and extensibility.

The iDAAS Platform is focused on all the FHIR Modules as defined below:

FHIR Module Types	Concept	FHIR DTSU
Administration	Patient, Practitioner, CareTeam, Device,	v3 - v4

	Organization, Location, Healthcare Service	
Clinical	Allergy, Problem, Procedure, CarePlan/Goal, ServiceRequest, Family History, Risk Assessment	v3 - v4
Diagnostics	Observation, Reports, Specimen, ImagingStudy, Genomics, Specimen	v3 - v4
Medications	Medication Request, Dispense, Administration, Statement, Immunization	v3 - v4
Workflow	Task, Appointment, Schedule, Referral, PlanDefinition	v3 - v4

Demonstration Background

The following section is designed to cover all the specific details of the demonstrations. Like any specific market it is important to have specific demonstrations that showcase specific market and vertical business understanding and directly showcase companies capabilities in addressing them. In order for the Red Hat healthcare team to build relevant market demonstrations it created a fictitious company named Care Delivery Care Delivery Corp US.

Care Delivery US is a US based organization that has coverage in all lines of the healthcare market. Below are some of their business capabilities:

1. They are a healthcare provider.

- a. Hospitals
 - b. Physicians
 - c. Clinics
 - d. Same day surgery centers
 - e. Various ancillary such as radiology services
 - f. Cancer treatment and chronic disease management
2. They have a fully owned subsidiary that provides healthcare support services they provide for themselves and some other healthcare organizations.
 - a. Billing
 - b. Staffing
3. They have another fully owned subsidiary that supports their IT needs.
 - a. Operations teams to implementing and supporting COTS products
 - b. Data Organization supporting reporting and analytics needs
 - c. Integration Organization to support their data integration needs
 - d. Develop some customized business driven solutions
 - e. Security organization to ensure compliance
4. They also are working to grow their capabilities in the life sciences space to support their healthcare needs around Cancer treatment and chronic disease management

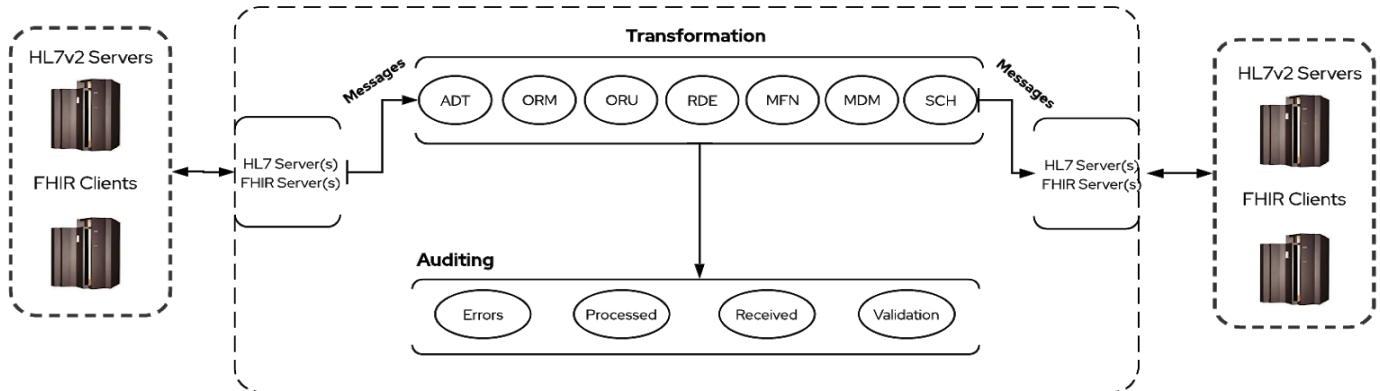
As they have been transitioning and starting to transform they have identified some very consistent industry challenges: lack of ability to innovate, data interoperability, experience problems from customer to patient to clinician to technologist. CareDelivery US looked to begin a digital transformation, in order to achieve any level of digital their technical leadership worked on and was able to get approved implementing a home grown platform, myEMR. myEMR is intended to be a

platform for all CareDelivery US to leverage for its go forward digital needs, the intent is to have it drive all clinical data needs. In order to start their work efforts they wanted to start integration for their enterprise standard clinical management information systems, Major Medical Systems (MMS) for one medical facility Medical Center TN (MCTN) and getting the following HL7 transactions: Admissions, Orders, Results, Schedules, Master File Notifications, Medical Document Management and Scheduling.

Enterprise Organization	CareDelivery US
Facility	Medical Center TN (MCTN)
Sending Application	Major Medical System (MMS) - Care Kiosk
Receiving Application	myEMR

Existing Implementation Scenario(s) - Visual

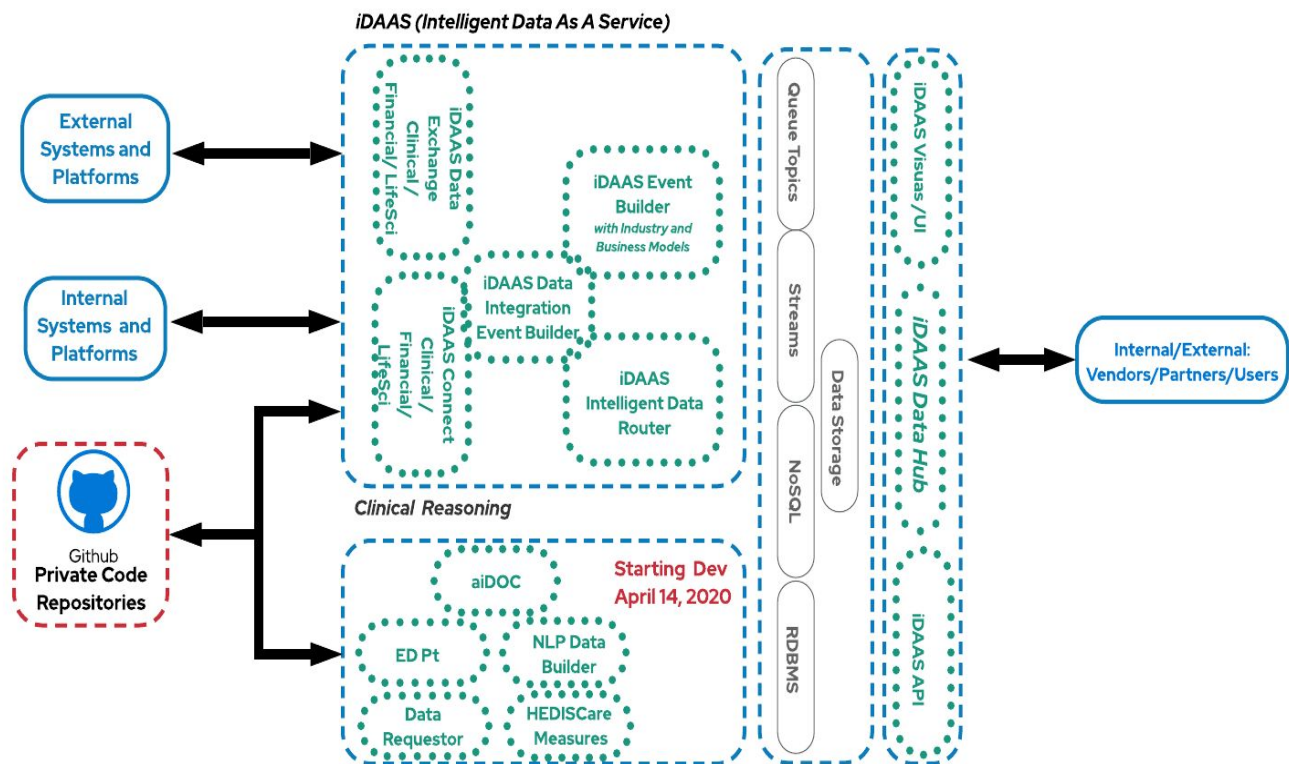
As they talked with their enterprise integration team they asked for a general architecture for this implementation. What they realized is they could not approach this effort like implementing clinical systems and knew they needed to develop an innovative approach to address their current and future data needs for this transformation. For general reference, below is a detailed visual of the base implementation they were initially provided:



Because of this architecture pattern, technical leadership realized they had a technical and potential resource problem. So they decided to look at the overall technical market landscape in general and quickly realized that they wanted to focus mostly on the Open Source market versus a series of COTS products. As they looked at the Open Source space Red Hat emerged as the leader. The technical leadership team realized that Red Hat had a very solid set of technologies to provide them the greatest range of capabilities for their current and future needs. From that decision came the details around what platform and capabilities can Red Hat provide?

iDAAS Platform

Red Hat's has several answers for healthcare needs. However, as a foundation is the highly extensible iDAAS platform that is made up of several key components, each of these components enable key functionality. Below is a visual of the way the iDAAS platform is constructed. You will notice another platform named Clinical Reasoning as well, this is a separate platform; however, it is enabled for rapid adoption by iDAAS.



Technologies

At the heart of the iDAAS platform is a series of products and technologies that are used.

Red Hat Based Products

Base Technologies: Red Hat Enterprise Linux, JBoss Enterprise Application Platform

Other Red Hat Technologies: Fuse (on Spring Boot), AMQ Streaming (Kafka), Decision Manager, OpenShift and Runtimes, 3Scale

Non Red Hat Based Products

Database Technologies: Postgres and/or SQL Server

Configuration(s)

The exact configuration parameters and details are being revised and put into a detailed separate document.

iDAAS Platform - Components

As we have mentioned several times a key focus on iDAAS is extensibility. In this section we want to cover the specific components within iDAAS. As you are reading through this it is important to ensure understanding that iDAAS is developed as a set of components working with industry leading technologies that enable us a broad range of capabilities, it is not merely a code base written in a programming language. The reason we have followed this pattern is that we can leverage a large set community to ensure we can address potential issues and concerns quickly with a large technical community. Let's do a walk through of the capability areas within iDAAS and the technologies that enable and power it.

- Integration: Ties back to Red Hat's Fuse and its upstream Apache Camel community. This technology is backed by one of the most active communities and continues to grow and expand this technology for well over a decade. As part of its commitment there are thousands of implementations of all sizes, types and scale levels in numerous industries with some of them growing to support 1 billion daily transactions. As part of its growth are the hundred plus

connectors that it natively supports, this will be very beneficial for Red Hat's healthcare team as the platform looks to grow and expand based on feedback and demand.

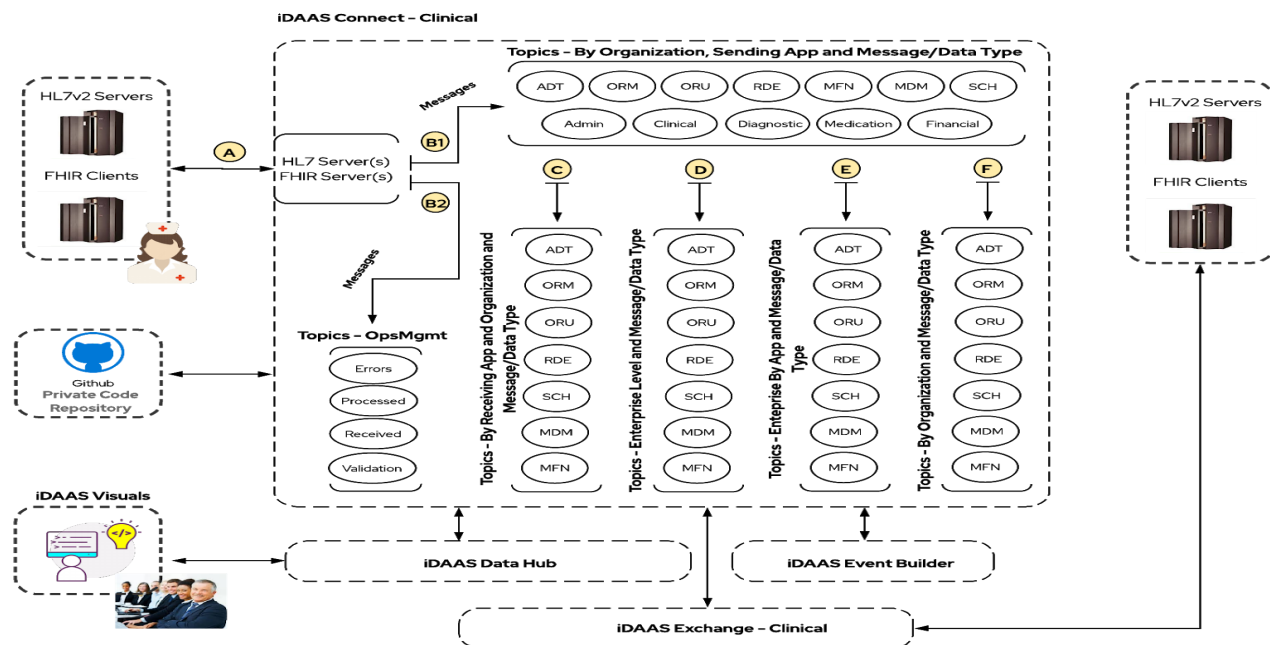
- **Business Rules:** This capability is supported by Decision Manager and the upstream Drools community. This technology is very largely adopted and implemented throughout the community. Drools has a very large footprint in organizations all over the world delivering expert based solutions and capabilities.
- **Queuing:** A key effort for us is enabling and building a high end data streaming and distribution platform. This capability is being supported by AMQ-Streams and the upstream Kafka community. We are also looking at future implementations with other distributed queuing technologies. *As a side note, within the codebase there is a codebase built atop Apache-MQ; however, we maintain the code ONLY for resources that would rather leverage that technology.*
- **APIs:** we have developed all the APIs leveraging .Net Core v3.
- **UX /User Interfaces:** The UX experience for the platform is currently driven by .Net Core v3 based assets and a very modern, responsive application design. These applications are best run on the industry leading OpenShift platform for scale. *The security model for these capabilities is currently being worked through to ensure the platform is demonstrable, the focus is on showcasing security and enabling the adopters to tie it to LDAP/AD or SAML based systems for the highest level of security.*

iDAAS Connect Clinical - Industry Standards

iDAAS Connect Clinical Industry Standards is designed and intended to provide message processing from HL7v2 and FHIR while providing routing and traceability services. iDAAS Connect Clinical Industry Standards is a key part of the central nervous system for everything iDAAS does and could

do, internally and externally. The platform as delivered is designed from a core reference architecture to support traditional message integration between two systems while also enabling enterprise data in the following manners: enterprise level by message type, enterprise level by sending application by message type, and facility level by sending application and message type. The platform also enables an operations management capability where all transactions are tracked for reporting and analytics.

As a side note, for other areas in healthcare there are specific connect platforms to enable their businesses.



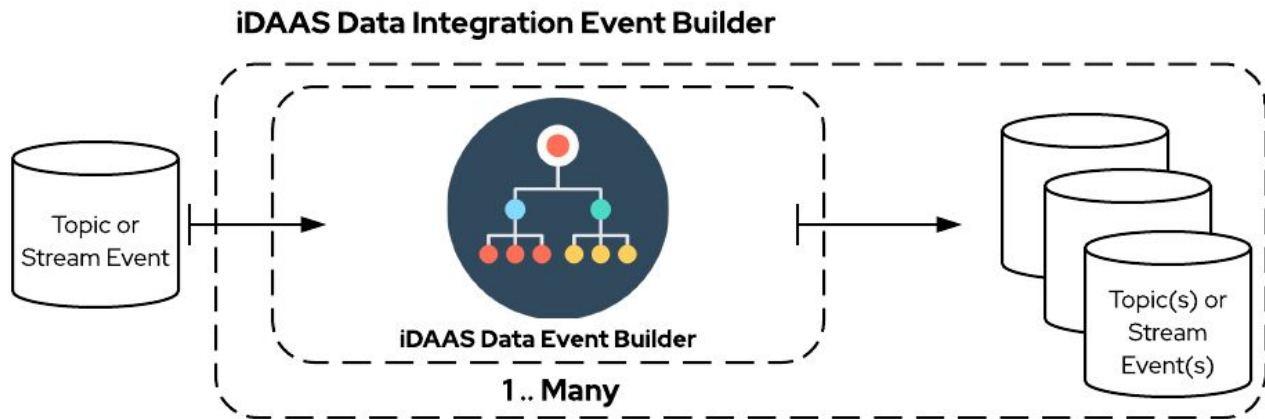
iDAAS Connect Clinical - Third Parties

iDAAS Connect Clinical Third Parties is designed and intended to provide message processing from non healthcare industry standard sources. This key connectivity layer was developed to ensure

iDAAS can leverage data from non healthcare industry standard based connectivity. While this project is new to the iDAAS portfolio it will provide connectivity to systems that support Kafka, JDBC, FTP/SFTP/ FTPS, AS400, HTTP/HTTPS, Rest API, Mongo and a dozen others to begin. Connect Clinical Third Party is intended to help grow and extend the importance of feeding data into iDAAS and help it support the central nervous system for everything iDAAS does and could do, internally and externally.

iDAAS Data Integration Event Builder and iDAAS Event Builder

iDAAS Data Integration Event Builder is what enables Red Hat, partners, SIs and developers to develop, extend or enhance the platform's ability to process data into any type of needed custom format for any type of needed processing. iDAAS Data Integration Event Builder is designed to call out and invoke needed events and can be customized based on business needs very quickly. The iDAAS Data Integration Event builder component ties to the iDAAS Event Builder core code base. By doing this we quickly enable implementation and adoption. The only thing past downloading the source code is setting up the appropriate way to include the iDAAS Event Builder so that it can be included. If you do not wish to leverage the existing code, enhance or extend it developers are able to add their own custom code for processing and object building.



iDAAS Data Hub

iDAAS Data Hub is where data relative to the platform is stored. Like the rest of iDAAS it is intended to be extensible. iDAAS Data Hub is a platform to enable processing of data into the various components and data models included. The key things Data Hub is meant to ensure resources have data driven insights from ANY activity the iDAAS platform will do. iDAAS focuses on enabling a detailed eventing model to iDAAS Data Hub for any activities the system does, this specifically is done through a transaction event which has a rich set of data attributes to track:

- The iDAAS action being leveraged
- The iDAAS component that is leveraging the action
- The date and time of the action
- The data involved within the component
- A subset of other attributes depending upon the action type: sending application, transactions processed, transactions generated, processing times, response times, and several more.

iDAAS APIs

iDAAS APIs are intended to provide a platform where any needed APIs or general capabilities are required for external access to the platform or its underlying data. The current APIs will support access to the iDAAS Data Hub and needed business artifacts for the platform.¹¹

iDAAS Visuals

iDAAS Visuals is intended to provide a platform where any needed capability requiring a user interface can be implemented and extended. This platform is intended to leverage and use iDAAS APIs and the iDAAS Data hub.

Source Code and Demonstration Data

The source code for all these demonstrations will be available, we are working through how best to layout the open or community source model to deliver these. **Currently, these repositories are private repositories and require being granted access.**

Below is a detailed set of links to all the other iDAAS GitHub repositories and their purpose.

iDAAS Platform Component	iDAAS Repository Link	Description
iDAAS Connect Clinical - Industry Standards	https://github.com/balanscott/iDAAS-Connect-Clinical-IndustryStandards	Connecting to healthcare Industry Standard based systems and platforms

iDAAS Connect Clinical - Third Party	https://github.com/balanscott/iDAAS-Connect-Clinical-ThirdParty	Connecting to third party based systems and platforms
iDAAS Data Integration Event Builder	https://github.com/balanscott/iDAAS-DataIntgrtn-EventBuilder	Data Integration framework to handle various forms of streaming data and invoke iDAAS Event Builder to output healthcare events.
iDAAS Event Builder	https://github.com/balanscott/iDAAS-EventBuilder	All the Parsers and Pojos used by the iDAAS platform, it can be referenced in any other iDAAS Platform component.
iDAAS Data DataHub	https://github.com/balanscott/iDAAS-Data-DataHub	Specific tier for ensuring end users can see transactions the platform has processed and reports. This is comprised on a scalable integration project and also includes the DDL for Postgres and SQL Server.
iDAAS Visual UI	https://github.com/balanscott/iDAAS-Visual-UI	Visual Tier for representing the platforms data and providing insight and related capabilities.
iDAAS Message Simulator	https://github.com/balanscott/MessageSimulator	This is currently a very small .Net Core console application. The intent is to grow and extend it to a feature rich component set for all iDAAS message testing needs.