

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

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Overview

There are many forces from a competitive, legislative or reimbursement perspective that are applying pressure across the entire healthcare market continuum. Over the last decade these forces have continued to both grow and morph, sometimes in exponential ways. Some of the external forces include 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 and information continue to increase, technical demonstration of value to business stakeholders, and areas like value based care continuing to expand. With all these forces the one thing healthcare sees consistently is their main means to address all these forces is found with 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 healthcare organizations business model(s): buy, build or a combination of buy and build the key remains that healthcare's effectiveness is driven by data driven capabilities from more accurate access to information in near real-time that can give them intelligence and enable them to have better platforms and capabilities in near real time.

Most healthcare organizations leverage some form of enterprise application integration platform to deliver integration. The most common healthcare "integration" approach is to send all data to all systems with little or no intelligence, some governance, and minimal data management. Some common industry terms for this we have heard are "spray and pray", "get once and send everywhere"

and “the integration firehouse.” Mixing this very common approach with most vendors providing solutions in healthcare are typically point solutions that are focused around a small, and very specific, subset of information more often than not is not a good mix. This integration practice puts organizations at risk for a series of technical issues but also mitigates the effect integration can have to transform healthcare organizations. Integration should be the innovation enabler for every healthcare based organization. Also, the majority of vendors providing enterprise integration platforms are also “black box” based COTS solutions.

Background - Industry Standards

Within the clinical integration space HL7.org is the group that manages and oversees the industry standards and has for several decades. For specifics and details on all the specifications they manage in healthcare, please feel to visit [HL7 Web Site](#).

HL7 v2.x

HL7 is the oldest standards in healthcare for enabling systems integration, 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. 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

FHIR, Fast Healthcare Interoperability Resources, is the modern current healthcare industry standardization approach to move healthcare from the dark ages of client-server connectivity towards a REST based set of capabilities. Unlike other attempts to modernize clinical integration standards FHIR is the future. It has been around for several years and already has a very large vendor community supporting and adopting it. The industry adoption from 2020 going forward adoption will dramatically increase with government mandates from CMS directly naming it as the means of compliance. From a simplification perspective are a set of modules and within the modules there are resources. Here is the latest version of [FHIR](#), please feel free to look.

*The iDAAS Platform is working on re-incorporating and testing for comprehensive FHIR support. We have decided to focus on what 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. **Also, we wanted to ensure we could support multiple third party vendor based solutions, so we are implementing this in a repeatable manner.***

iDAAS Platform

Red Hat's healthcare team wanted to design a platform that could transform healthcare and bring a new mindset into the technology side of healthcare, an open source community driven focus on building platforms. When thinking about how to drive an open source community driven focus it was very clear that any platform would need at its foundation a high-level series of capabilities and features that would drive it forward. As the team planned there was lots of industry engagement at industry conferences, Red Hat events, customer meetings and industry expert groups like IDC.

Here are some of the capabilities that were expressed, the Red Hat Healthcare team wanted to try and ensure a theme, so these are called "the five R's":

- **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. From a third party connectivity perspective we focus on building an on-ramp for data to be leveraged within iDAAS for over 75 common protocols like JDBC data sources, File, FTP, SFTP, FTPS, APIs, WSDL, AS400, Mongo, Kafka, numerous cloud platforms and many more.
- **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) to form the intelligent healthcare data router.
- **Run:** This is one of the most exciting capabilities we are enabling. This is done through our DREAM component. DREAM, Data Realtime Exchange Automated Management, is all about

driving change in the healthcare community and building out a value exchange that can be used by anyone implementing iDAAS to add new capabilities in a low latency and very low risk. You would build a component that has the capability of acting on streaming information and being invoked in a real-time manner. These activities could include areas like event population and building, business rules enablement, third party application integration, AI, ML, dynamic mapping of data sources, cross mapping codes and many other potential examples.

- **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. This includes our ability to enable real time clinical information to be tagged as its passing through the platform.

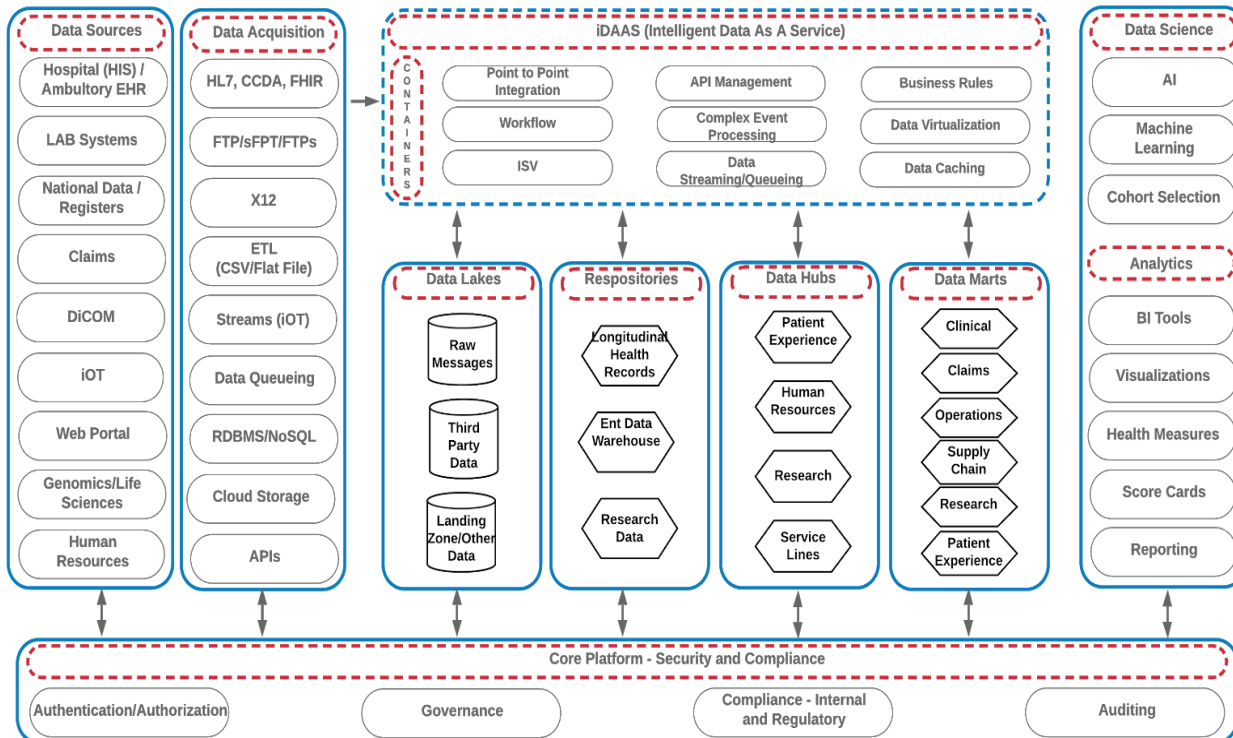
Here are just a few of the features discussed to ensure were a focus of the platform:

- **Modular** – platform is designed to be a series of components that can work together to ensure capabilities are met and extensible for future needs.
- **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.
- **Innovation based** – download the code, any of the specific repositories, and leverage for your needs with the complete ability to extend as needed. At its simplest, the platform drives innovation.
- **Healthcare market and need focused** – goal is to enable the healthcare market to drive innovation and reduce the barriers for data access while providing transparency to all aspects in the data integration platform.

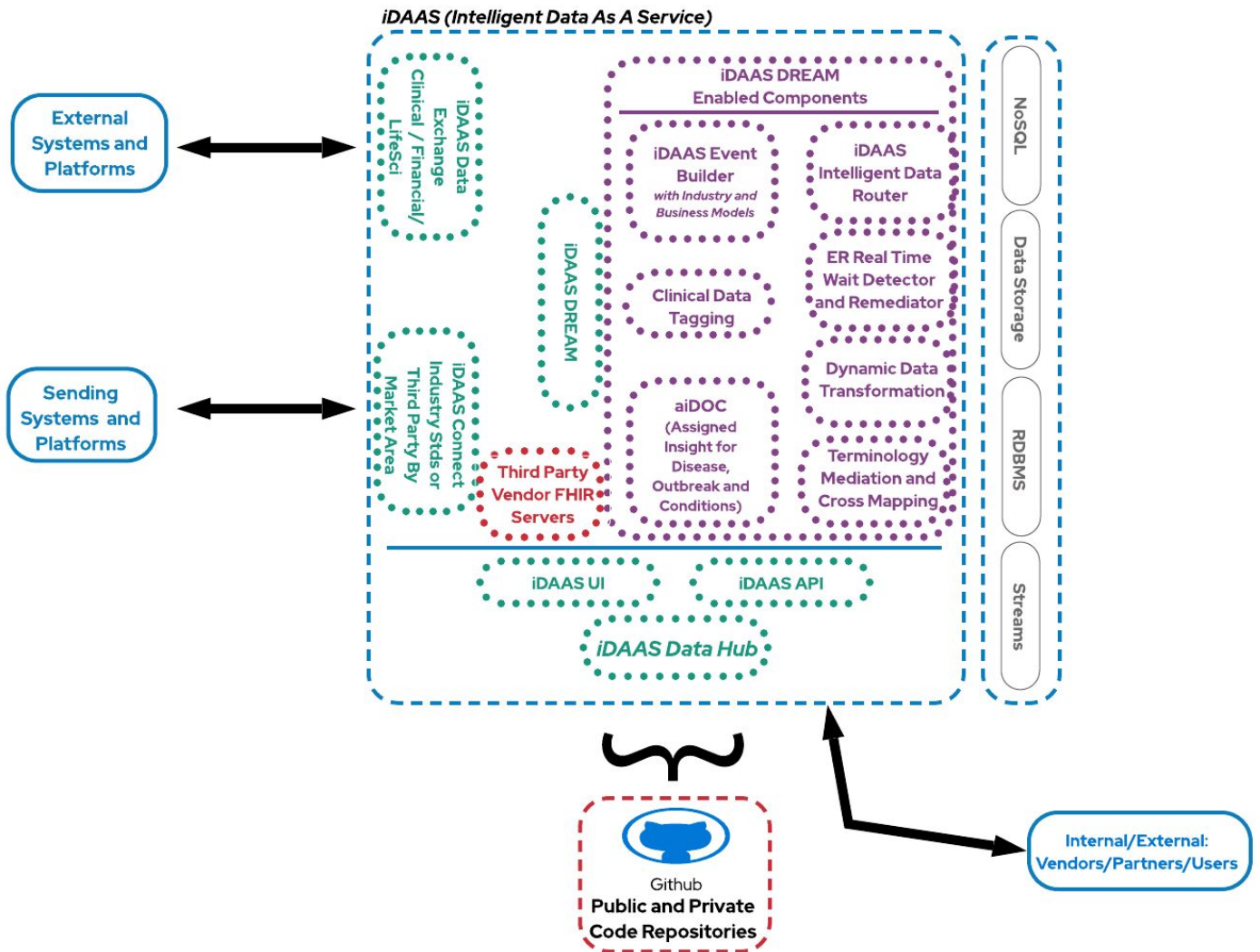
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- Low Code and No Code enabler - when and where possible we want to ensure that the platform can be tuned on demand without the need to do traditional activities like starting and stopping “interfaces” to have changes go into “production”. Capable 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.
 - 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.

From the high-level capabilities and features the team then focused on if it could be delivered and then implemented. After even more quick research and discussion the answer was “yes”. As the team worked through these efforts a code-name was born, iDAAS. Intelligent Data As A Service (iDAAS), was such a simple name because the driver for any application and integration is all about data but that data needs to be more intelligent. Since iDAAS is built to be 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 at a very high level how and where Connected Health/iDAAS fits within a healthcare enterprise and the various ways it works with data.



In order to drive a high level of extensibility the iDAAS platform is built to be component based and driven. The key driver for any component is to help iDAAS fulfill a level of feature functionality. Below is a visual of the way the iDAAS platform is constructed.



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 (as needed for APIs)

Non Red Hat Based Products

Database Technologies: Postgres and/or SQL Server

iDAAS Platform - Components

As we have mentioned several times a key focus on iDAAS is extensibility. In this section we want to cover the current 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 the team has followed this pattern is that we can leverage a large technical community to ensure we can address concerns quickly and continue to expand for future needs and capabilities. To enable and support the capabilities needed within iDAAS, the platform will leverage the technologies mentioned below specific to the specific need.

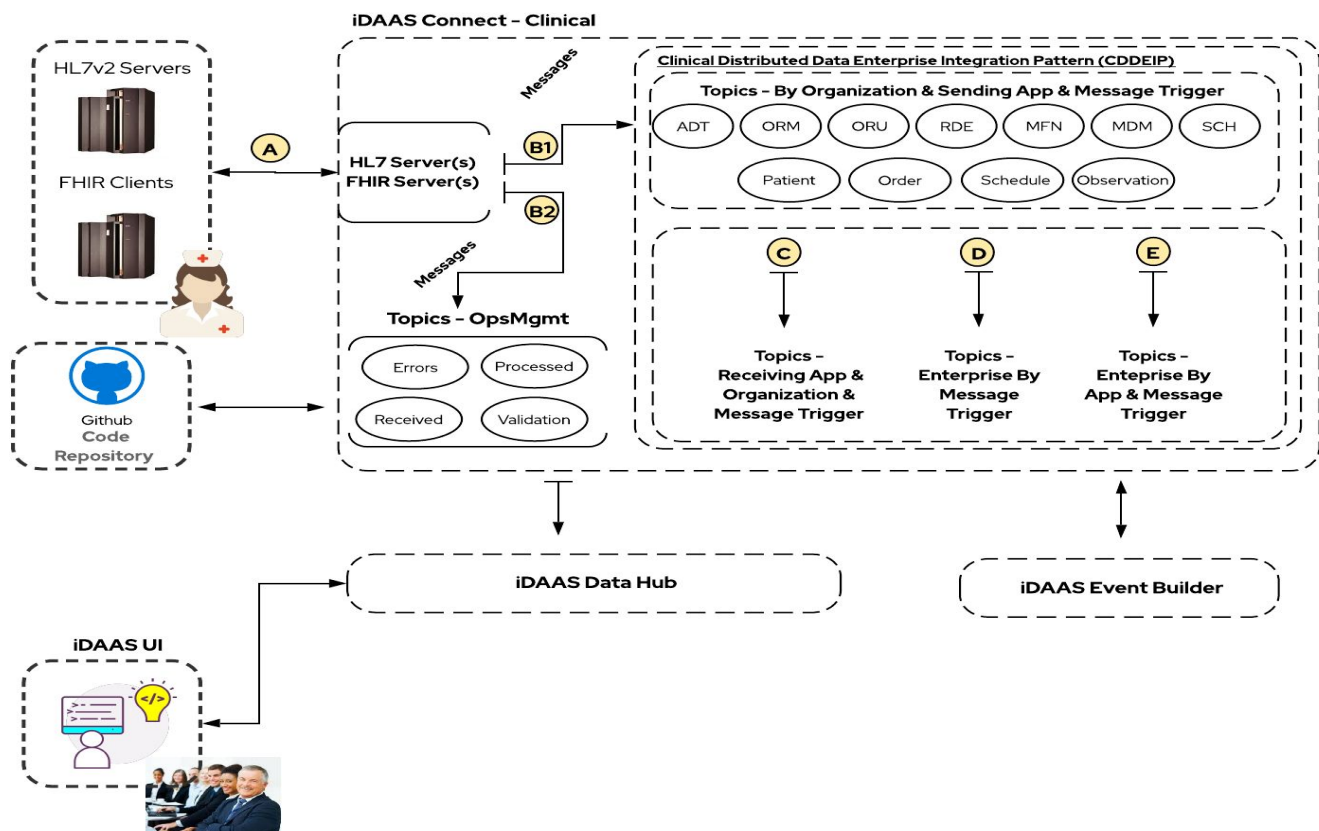
- Integration: Ties back to Red Hat's Fuse and its upstream Apache Camel community. This technology is backed by one of the most active communities and continues to grow and expand this technology for well over a decade. As part of its commitment there are thousands of implementations of all sizes, types 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.

- Data Streaming: 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 - Industry Standards

iDAAS Connect Industry Standards is designed and intended to provide message processing per vertical specific market. We did this to ensure that every specific area of healthcare: clinical, financial, life sciences would be able to function as they need to without any blockers from other areas. So, for iDAAS Connect in the clinical market we call that iDAAS Connect Clinical - Industry Standards and it directly supports HL7v2 and FHIR transactions while providing routing and traceability services. iDAAS Connect 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 EAI (enterprise application integration) message

integration to enable any data to become enterprise data. This is done through the Clinical Data Distribution Enterprise Integration Pattern (CDDEIP). The CDDEIP is intended to drive enterprise level in a simplistic manner by merely distributing messages through a proven pattern. Because of the enterprise integration pattern and knowing how critical auditability is 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 - Third Parties

iDAAS Connect Third Parties is designed and intended to provide message processing from non healthcare industry standard sources. With this implementation we have followed the same development pattern by having a specific implementation per market within healthcare due to usage patterns and the potential for reusability due to common industry systems or platforms being leveraged. 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 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.

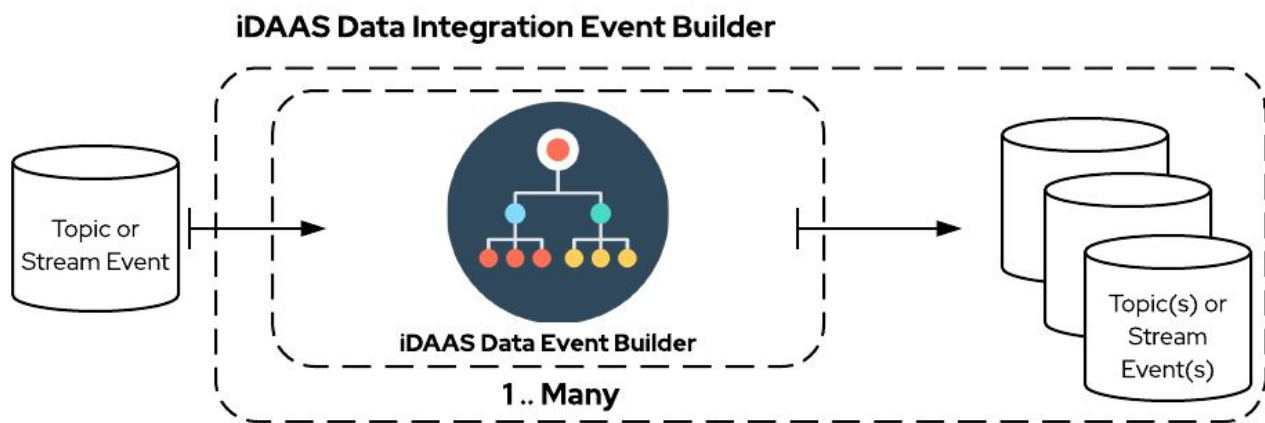
iDAAS DREAM

iDAAS DREAM, Dynamic Runtime Extensible Automated Management, is a very powerful component and enabler of iDAAS. Its design intent is to enable Red Hat, partners, SIs and developers to implement iDAAS and/or other capabilities internal or external to iDAAS in a dynamic manner without the need for stopping the platform and needing to restart it to work with data while adding new features.

iDAAS Event Builder

iDAAS 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 Event Builder is designed to call out and invoke needed events and can be customized based on business needs very quickly. The only thing past cloning the source code is setting up the appropriate way to include iDAAS Event Builder jar files 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. A key thing to note in the data model and events the system focuses on is a way to associate one organization to many healthcare entities and to many applications and within each application any components wished to be defined.

This is ALL up to the implementation. Because of this data enablement 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.

Partnering Organization for Connected Health/iDAAS

In order to address the healthcare market needs Red Hat's healthcare team needed to ensure they had a real world market focus to build out relevant market demonstrations and workshops for the platforms it was creating. To help achieve this Red Hat Healthcare created a fictitious healthcare company named Care Delivery Corp US, it's acronym is [CADUCEUS](#) (the medical symbol). The intent of doing this is to have a healthcare enterprise that resonates within the healthcare market.

Here are all the various areas of healthcare the Care Delivery Corporation US will help Red Hat healthcare demonstrate its relevant platform(s).

- Healthcare provider service(s)
 - Hospitals
 - Physicians
 - Clinics
 - Same day surgery centers
 - Various ancillary such as radiology services
 - Cancer treatment and chronic disease management
- Provide healthcare support services they provide for themselves and some other healthcare organizations.
 - Billing
 - Staffing
- Provide support for their healthcare services IT needs.
 - Operations teams to implementing and supporting COTS products

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- Data Organization supporting reporting and analytics needs
 - Integration Organization to support their data integration needs
 - Develop some customized business driven solutions
 - Security organization to ensure compliance
 - Life sciences space to support their healthcare needs around Cancer treatment and chronic disease management

Scenario: IT Digitization

As with any organization, irrespective of industry or market, Care Delivery Corp is re-evaluating its overall IT capabilities as a by product of needing to move into the digital realm. This re-evaluation is also being heavily influenced by their need to also prepare for upcoming government mandates around interoperability requirements specific to data access, not only for their patients but also their other businesses as well. Through the journey of their re-evaluation of capabilities they have identified some very consistent challenges they are having: lack of ability to innovate, vendor lock in, data interoperability incapacities, without waiting for numerous vendors, experience problems from partner to customer to patient to clinician to technologist. Based on all these findings, Care Delivery Corp has decided to start their digital transformation and implement a home grown platform, myEMR. myEMR is intended to be a platform for all Care Delivery 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) platform called Care Kiosk.

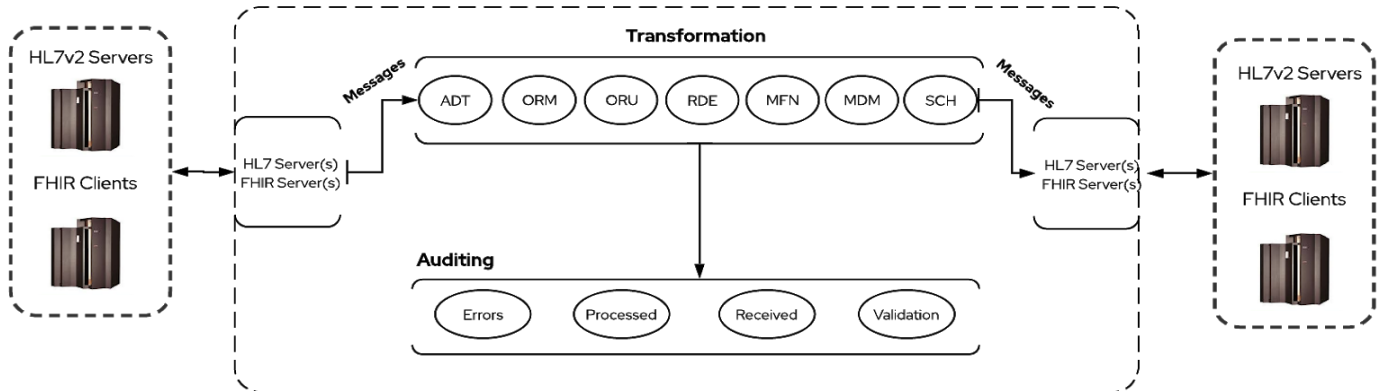
Enterprise Organization	CareDelivery US
Facility	Medical Center TN (MCTN)
Sending Application	Major Medical System (MMS) - Care Kiosk

Existing Implementation Scenario(s)

As Care Delivery Corp US talked with their enterprise integration team they asked for a general architecture for their digital implementation needs. The plan is for one medical facility Medical Center TN (MCTN) and getting the following industry standard transactions processing:

- HL7 v2: Admissions, Orders, Results, Schedules, Master File Notifications, Medical Document Management and Scheduling
- FHIR: All FHIR resources and APIs needed to support Interoperability requirements.

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:



Challenging The Technology Practices in the Industry

As they talked with their enterprise integration team the leadership team realized that they have 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?

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 moving to public repositories through May 8, 2020.**

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/redhat-healthcare-chiefarchitect/iDAAS-Connect-Clinical-IndustryStds	Connecting to healthcare Industry Standard based systems and platforms
iDAAS Connect Clinical - Third Party	https://github.com/redhat-healthcare-chiefarchitect/iDAAS-Connect-Clinical-ThirdParty	Connecting to third party based systems and platforms
iDAAS DREAM	https://github.com/redhat-healthcare-chiefarchitect/iDAAS-DREAM	iDAAS Data Runtime Extensible Automation Mgmt framework to handle various forms of adding processing capabilities in a near real time manner.

iDAAS Event Builder	https://github.com/redhat-healthcare-chiefarchitect/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/redhat-healthcare-chiefarchitect/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 DataHub UI	https://github.com/redhat-healthcare-chiefarchitect/iDAAS-Data-DataHub-UI	Visual Tier for representing the platforms data and providing insight and related capabilities.
iDAAS Message Simulator	https://github.com/redhat-healthcare-chiefarchitect/MessageSimulator	This is currently a very small .Net Core console application. The intent is to grown and extend it to a feature rich component set for all iDAAS message testing needs.