Whitepaper
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Healthcare Open Source Innovation Platform (OSIP)

Authors

Dr. med. Pascal Walliser, pwalliser@fluance.ch

Christian Benesch, cbenesch@fluance.ch

Jonas Botta, jbotta@fluance.ch

Haider Husain, haider@healthinnova.com

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Introduction

Current Healthcare Landscape

Corporate IT is often dominated by large, established and enterprise business applications that are mature but inflexible. Healthcare is largely the same, compounded by a higher fragmentation of applications in the IT ecosystem due to varying and increasingly specialised clinical domains.

Like other industries, healthcare organisations often try to address all their organisations needs with one application that provides many modules, that works as a clinical Enterprise Resource Planning system (ERP) and is often termed as an Electronic Patient Record system (EPR). This is generally quite costly, either as a capital or subscription expense, and comes at the additional expense of a lack of flexibility. These kinds of systems tend to dictate workflow and functionality to the user, without the ability to adapt to an organisations' specific needs.

Another common approach is 'best-of-breed', where groups or individuals within an organisation select the most appropriate solution for a specific need, at a specific time. The result is a highly fragmented environment coupled with an inability to consolidate data for secondary uses e.g. management dashboards with real-time information. Additionally, the solutions are slow to change to support changing processes or trialling new models of care.

Open Source Innovation Platform (OSIP)

Whichever approach is prevalent in an organisation, deploying a flexible data platform alongside the existing infrastructure unlocks data silos and facilitates interoperability and innovation.

Data management middleware: The OSIP is a service-oriented environment with the ability to connect to any other system. It is sent and can also extract data from silos and makes it available in a secure and auditable manner to the rest of the IT ecosystem. The organisation is therefore able to continue to benefit from legacy systems as long as it is needed and at the same time share crucial data with other parties safely.

Data persistence: The persistence layer also makes sure that the organisation is not constrained when transporting data from one system to another. It can also be used to combine data from different sources and create new business rules.

Standards: Using common IT and healthcare standards, access to clinical and business data is fully secure manner and available from anywhere using web-API's. This provides the ability to connect additional apps and systems to your environment without compromising security.

Flexibility: Healthcare organisations need a flexible innovation platform on which to nurture and test ideas and functionality in a safe and secure environment, using real data. The platforms modular nature means an organisation can deploy the elements that matter most, when it matters most.

Cost Effective: When designing the OSIP ensure that it was accessible to all was a key requirement. A large part of this is cost, and so all components that have been selected are open-source and available to download freely. This includes the code and scripts that are written by Fluance which provide the 'wrapper' around the 3rd party components.

This whitepaper details the scope and functionality that the OSIP provides, and the typical scenarios that the platform provides value to.

Innovation and Open Technology

Innovation in Healthcare

The Healthcare OSIP is an environment specifically designed to nurture innovation in Healthcare, in addition the same infrastructure can be utilised to connect legacy systems and siloed datasets.

The OSIP provides a standardised platform and framework that supports agile development, allowing newly developed and existing applications the ability to access appropriate clinical and demographic datasets of the organisation, with near real time updates.

It is comprised of open-source components, that have been carefully selected to ensure they operate well in a healthcare environment, alongside the safety, speed and security requirements that are essential.

The goal is to provide an environment for innovators within the organisation to prove their concept in a familiar and relevant data context, while minimising costly investment in new applications and their integration.

The OSIP utilises modern components in order to create a flexible platform that can integrate with existing applications as well as provide the infrastructure to allow new ideas and concepts to be trialled, tested and evaluated quickly and if beneficial, rapidly deployed in a safe and secure environment.

A Healthcare Platform

The platform and technology could be used in any industry however it is optimised for healthcare and built to support healthcare messaging standards eg. HL7 or FIHR. Where necessary, bespoke code has been written and this specifically supports clinical data. OSIP is therefore designed to work best in a clinical environment and utilises common healthcare standards.

Open Platform

The Apperta Foundation (https://apperta.org/) published a paper in November 2017 entitled "Defining an Open Platform" that describes how a multi-solution, multi-provider and multi-vendor platform for healthcare should be implemented. They essentially desc ribed the common standards and the implementation methodology to achieve that goal. It is important to realize, that "Open" in this context doesn't mean "non-commercial" or "free of charge". It's simply a way of integrating solutions to an ecosystem, that allows the free exchange of data between the players, and normally based on the use of documented open-API's.

Open Source Software

Open source software can be defined as software or programs for which the source code is freely available and freely redistributable, with no commercial strings attached eg. licence fees.

The healthcare software market is a conservative environment dominated by well established companies, with a few start-ups emerging. It is very difficult for newcomers to launch successfully due to the need for proven outcomes and references that are often lacking when a company first enters the market.

The OSIP is part of a new wave of software that goes against the traditional grain, and intends to nurture collaboration and innovation, though open technology and the use of standards.

We publish our code under the Apache 2.0 license and most of the used components are under the same or another similar license. (https://www.apache.org/licenses/LICENSE-2.0)

OSIP Functionality

Data Collection

One of the primary functions of the OSIP is to collect and store data, from any system. This is especially useful when connecting to legacy systems that do not have easily accessible data stores through open API's, and have therefore built up 'siloed' data. The OSIP provides a mechanism for such silos to be accessed and data stored in a secure but open and vendor-neutral repository. It also means that the information and granularity of the original data is kept and made accessible without the original system.

Data Aggregation

As the data repository grows, it can be aggregated in any way the organisation chooses. Increasingly, a patient-centric view of the data is needed to provide a holistic view of the patient e.g. lab data from different providers could be structured in chronological order rather than by provider. This is just one example and essentially the type and method of aggregation should be dictated by the organisations needs and focus.

Data Federation

Storing data is the first step, but the real goal is to use this data in a clinical environment, providing the clinician with the right information at the right time to best provide care for the patient. Therefore, we need to make this data accessible. To achieve this we built easy-to-use APIs and a security layer. This is the ESB or Enterprise Service Bus. This middleware ensures that the right data is available in the right place to authorised providers. A log and audit trail is also built in by default.

Data Transformation

There are many reasons to transform data from supplying it in a different format to third party systems to generation of new information based algorithms utilising existing data. This can easily be accomplished with the OSIP.

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Identity Federation

In healthcare you often have a mix of corporate identities, usually on a Microsoft Active Directory and a multitude of system based user identities. The OSIP can federate existing identities as long as they conform to an established security standard. In addition to that it can provide and maintain identities of its own. Both can be used by third parties giving the ability, to use common logins for all connected parties.

Enabling innovation on legacy systems

Being modular, open source and open standard the OSIP can easily be adapted to existing environments. It is possible to build a modern ecosystem without compromising the role or functionality of key systems in use. These systems do not have to be replaced before it is necessary and the data they hold is also secure in a separate repository minimising the need for costly data migration activities.

Bridge the gap

In most healthcare environments, the changing business needs dictate the priorities and this often leaves gaps in the overall system architecture. The OSIP can act as an integrator, translator and interpreter between systems that are unable to interact directly. In addition to simple point-to-point integration the platform provides full control over your data and monitoring of activities.

Web Apps

Sometimes you have the data but not the right user interface. OSIP can provide its own app environment. These web apps are easy to develop and adapt to specific needs and need no installation. They run on all modern platforms as long as the UI suits the screen size.

Outside the current scope of OSIP

Medical Imaging

OSIP currently does not have the ability to store medical images. There is no DICOM connectivity and no storage configured for multimedia files. There is also no image viewer.

If this functionality is needed we suggest linking OSIP with an open source picture-archiving-and-communication-system (PACS) or a multimedia archive. These platforms usually provide a notification service that includes the information needed to link an image to a patient. With that link it is fairly straightforward to integrate a web-viewer from the imaging system or open a third-party viewer.

Documentation Management

OSIP stores data at its lowest level ie. granular data. For documents management it is possible to connect a dedicated storage or a vendor neutral archive (VNA). Much like medical imaging, you can link a document with a patient through a notification service provided by the VNA.

Master Patient Index (MPI)

OSIP uses existing unique patient IDs to identify a patient and to group their data. These ID are normally generated by the EPR or PAS (Patient Administration System). It can also use any unique ID for example a social security number. If you want to connect systems without common IDs, you will need an MPI provider to reconcile the data.

Primary system

The goal of OSIP is to provide a framework for the management data, while at the same time allowing the data to be used for secondary purposes such as innovation. In some specific scenarios you may also want to use it to collect data however it should be noted that although this is possible it is not its intended use.

Main components of OSIP

The components that make up the OSIP have all been carefully selected for their flexibility, functionality and applicability to healthcare.

Messaging Layer: I/O server

Most legacy systems can only interact thorough file-based interfaces in a semi-standardised format. To capture that data and to interact with these systems you need a robust I/O engine. Ideally you should be able to configure new data streams without affecting existing ones. And your system should be able to scale without performance issues.

OSIP achieves this by using the mirth-connect engine now called "NextGen Connect" in the open-source version (https://www.nextgen.com/products-and-services/integration-engine). It should be noted that additional code has been developed and is provided to complement the interface engine and ensure it works well within a healthcare environment.

Data Layer: Database

Granular data stored in a relational database makes up the persistence layer of the OSIP. This RDBS (Relational Database System) contains the patient data, the app specific data, the user data, all the logs and everything else that the platform needs to operate. Our configuration allows load-balancing where needed and the use secure replication to connect an on-premise environment to the cloud.

We use PostgreSQL as this is the world's most advanced open source relational database (https://www.postgresql.org/). PostgreSQL was also the first RDBS to address the need to store some non-SQL elements. This is essential when storing JSON messages with variable content.

Security Layer: ID server

KeyCloak provides a powerful and standard conformant ID-server (https://www.keycloak.org/). Federating corporate identities is essential and being able to federate social-media identities and act itself as an ID provider is becoming more and more important. Furthermore, this server is the key to our internal access management.

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Middleware

An established workflow engine could be used to power your business' processes, however as healthcare data and associated workflow are fairly unique to healthcare, we chose to program the business rules from scratch rather than adapt and be constrained to existing tools.

Therefore, our middleware is fully custom code written in Java. This programming language is one of the most used and well adopted in all industries. It is platform

agnostic and runs well almost anywhere. We use OpenJDK to ensure we have the correct open source licenses (http://openjdk.java.net/).

Web apps

Our web apps are developed in Angular (https://angular.io/). We believe that this is the most versatile framework for our type of application. It gives us the ability to use the system resources of end users' devices and allows us to bridge some network gaps in mobile and Wi-Fi networks. With modern system environments you can even provide progressive-web-apps (PWA) and improve the overall end user experience.

System environment for OSIP

Infrastructure layer: the key to flexibility

A typical system environment for our framework would consist of several Linux servers (Ubuntu LTS). However, we've decided to pack all our components in Docker containers (https://www.docker.com/). This gives us the ability to run our environment on many different types of servers, as long as there is a docker instance or a similar runtime.

Orchestration

To achieve a high availability of our platform, we suggest the use of Kubernetes (https://kubernetes.io/). However, this is not mandatory and must be provided by the customer.

Move to the cloud

By using Docker and Kubernetes, we are by default platform agnostic. OSIP can be installed and operated on all kind of environments. We suggest running it in a cloud environment, because we believe that modern clod offerings are the most secure environments a healthcare institution can afford. However, all common deployment choices are supported i.e. on-premise, private cloud on Amazon AWS, Microsoft Azure or anything else.

Serverless

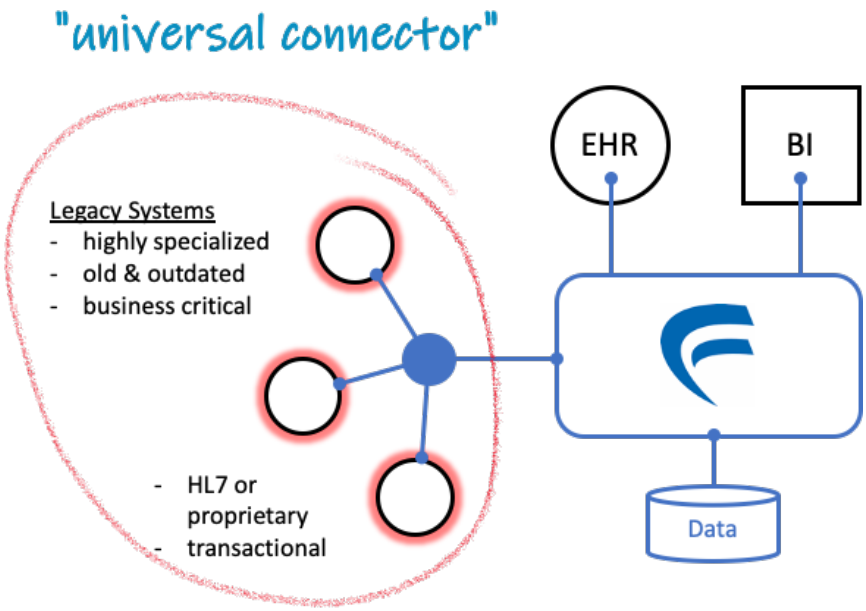
If you decide to run part of OSIP in a Microsoft Azure Cloud environment, we can use some native serverless components. Usually these perform better than the same system in a Docker container.

Implementation scenarios

Integration of legacy systems

In a specialised clinical environment, you sometimes have to use some outdated equipment which is perfect for a specific task but lacks any standard interfacing options. OSIP can connect these systems to the rest of your ecosystem and share their data to third parties safely and securely.

With OSIP you can continue with a best-of-breed strategy and in addition implement a company wide data management strategy.



Orchestration of dataflows

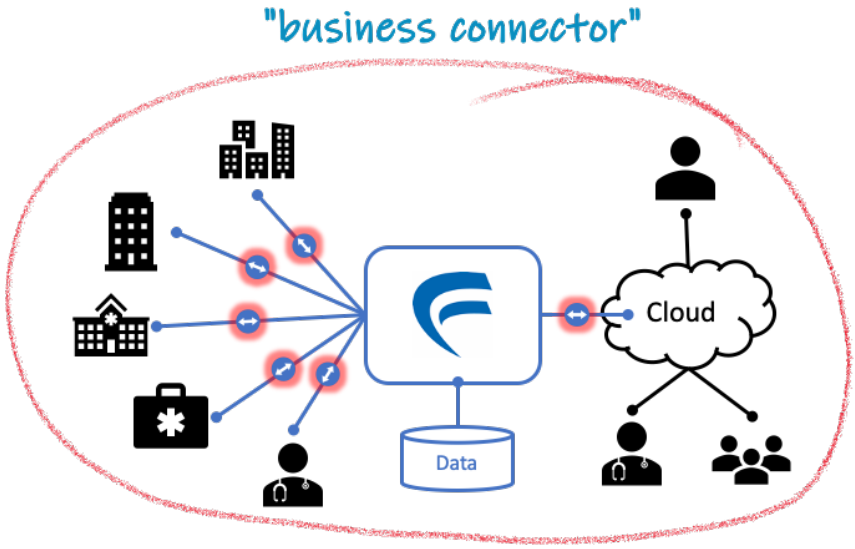
Most of your clinical and administrative systems need similar patient related information. Far too often users still spend their time copying data from one system to another. Peer-to-peer interfacing from one system to another can solve some of this pain, but it's difficult to keep track of your data flows the more systems you try to connect and maintain these interfaces if systems are updated.

Using OSIP as an enterprise application integration (EAI) tool, you can connect your systems directly to one instance and manage your data flows through it. This gives you the ability to monitor traffic and to implement appropriate business rules.

Connect different work sites

Healthcare providers tend to aggregate business from different sites. This may stem from organisational mergers or organic growth, and often results in IT departments spending effort and resources to synchronise systems and solutions.

With OSIP you are able to connect multiple sites with different primary systems and still be able to exchange and consolidate patient specific data. You can connect to external partners without giving them access to your internal network. We also support the use of public cloud providers to assist with this.



Provide an ecosystem for apps

The leadership and innovation team of the average healthcare provider normally receives plenty of suggestions to implement different kind of apps and functionality. While many of these apps are not mature enough to be used in a professional healthcare environment, there are still some good and innovative ideas. However, connecting apps to your existing legacy systems is painful and often does not provide the desired results.

OSIP gives you the ability to connect apps through simple and well secured APIs. You're not dependent on the willingness of your providers to create standard conformant interfaces. Instead you can fuel some brilliant app programmers with a simple way to interact with your data without risk and at minimal cost.