The EHRs Reference Implementation

Prototyping an Enterprise Service Bus infrastructure for health systems interoperability
Technical Report, April 2011

this report:

An Enterprise Service Bus for Healthcare

Synergy is defined as a system being greater than the sum of its parts. This word captures the true definition of an Enterprise Service Bus (ESB). ESB is an architectural pattern where systems subscribe to traffic that is published to a centralized bus. This allows the system to orchestrate, aggregate and report on data seamlessly.

Service bus technology detaches the developer or consuming application from knowing all the information about "what" needs to occur to perform an action. The bus exposes a federated endpoint (known as an on-ramp) and orchestrates communication between the necessary parties to perform an action. For example, it is possible to pose the question "What happened to John Smith this month?".

In addition to this, a service bus allows consuming applications to communicate using one standard, regardless of what standards are being used by the legacy systems. Through a process known as off-ramping, systems can communicate with the bus using HL7v3 which may result in an XDS message to a document registry.

The EHRs reference system as developed by Mohawk College has been implemented using this pattern, and facilitates interoperability of systems, providing patient centered data.

A FLEXIBLE SOLUTION

The Electronic Health Record System (EHRs) at Mohawk College is designed to test the interoperability of systems. Through a process known as on and off ramping, various third party software products can be "swapped" in or out of the EHRs.

This flexibility allows us to quickly perform integration tests with software products.

THE NEED FOR AN EHRs

Currently, many software products lack the ability to share real-time transactional data with each other.

- Functionality is duplicated, meaning increased costs for developing and maintaining
- Accessing a remote HIS/EMR requires portal access.
- Impossible to get an "overall" patient summary

An EHRs alleviates these problems by providing a federated system that provides access to the longitudinal record of a patient. Providing truly patient centric health care.

Sharing data across systems boundaries

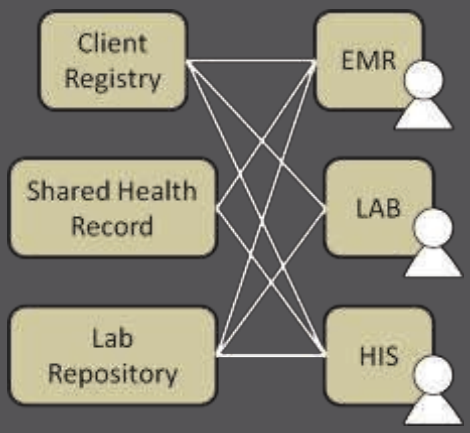
The EHRs crosses the boundaries of any one system, providing an aggregate view of patient data. A truly patient centric data model.

Most patients will have more than one type of data during their lifetime, so doesn't it make sense for each data repository to share data?

The primary objective of the EHRs reference implementation is the sharing of data in an interoperable manner. The data exists to answer the question "what happened to John this month", and the EHRs provides the assembly line that aggregates the data.

Point-to-Point Solutions

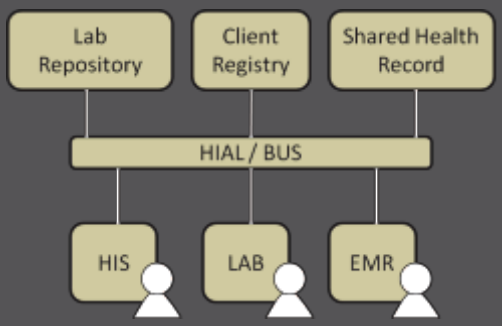
Many solutions exist that provide integration using a point-to-point system. While this approach is easy to develop, maintaining infrastructure can become problematic as each new system introduced into the mesh introduces $(n^2-n)/2$ communications interfaces.



In a system with 500 points of integration, this means that over 120 thousand communication interfaces would be required.

Federated Design for Integration

The EHRs facilitates sharing of data through an enterprise service bus. In this type of system a concept known as publishing and subscribing (or pub/sub) is used. In this model, data repositories are connected to the bus (the HIAL in blueprint speak) and subscribe to events that they can usefully process.



Above the HIAL components offer services that complement the process of performing an operation while below the HIAL components consume those services.

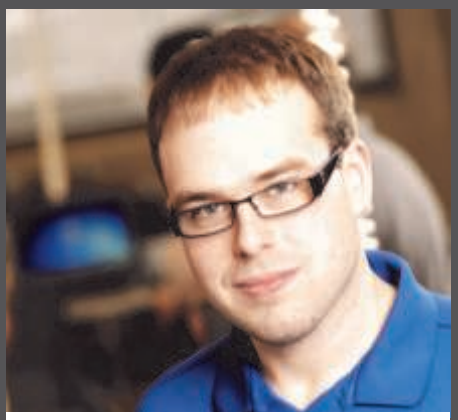
For example, an HIS may publish a discharge event which is subscribed to by the Shared Health Record (SHR), which may trigger a publish for patient identity cross reference subscribed to by the Client Registry (CR).

The key concept is that all systems communicate with the bus. No two systems directly message each other. This gets rid of messy point-to-point integrations and eases integration. It also means that the bus can determine how to message the remote system providing "black-box" communications.

Patient Centered Views

The bus can also be used to aggregate data. An EMR publishes a request for patient summary (all records in all repositories). This request is subscribed to by the Longitudinal Record Service (LRS) which can publish summary queries back onto the bus.

After receiving the responses from each query, the LRS can assemble this data into one message and publish the response back to the client.



The EHRs Blueprint

Although the EHRs Reference Implementation was developed at Mohawk College, the architecture is the brainchild of Canada Health Infoway.

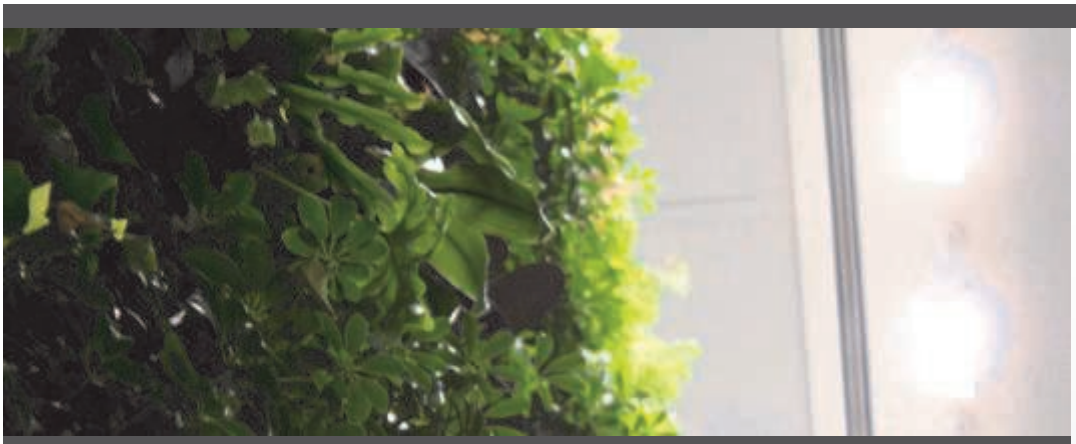
The blueprint itself is not a software product, rather a design for a system. The blueprint is software and standards agnostic meaning that it can be implemented using a variety of standards and software stacks.

The architecture describes a centralized communications bus, commonly known as the Health Information Access Layer (HIAL). Systems above and below the HIAL publish and subscribe to events on the bus.

Sometimes events can simply be subscribed and routed to a registry. Actions like finding a patient, or discharging a patient are examples of simple message routing.

Other events require a more processing, which is the role of the Longitudinal Record Service (LRS). The LRS uses the index (which is like a table of contents for a patient's record), queries the appropriate systems and aggregates data, providing patient centric view of data.

In addition to this, the blueprint also provides secondary use information via the Health Information Warehouse. Records are de-identified and used by agencies like the Canadian Institute for Health Information (CIHI) to detect and address problems in our healthcare system.



An interoperable ecosystem

Standards based interfaces are the key to an interoperable ecosystem. Many standards exist that provide standard functionality such as looking for a patient, creating a discharge, or finding current medications.

Standards are extremely useful as they allow a product to be chosen based on features rather than integration capability. They also permit swapping-out or "changing" vendors if features aren't available or costs escalate.

In the past, the EHRs reference implementation has leveraged standards to promote interoperability within the system. In 2008, the EHRs used the Initiate Client Registry which uses PIX/PDQ, in 2009 Karos Rialto was used and no change was needed to other components within the infrastructure.

The EHRs further promotes interoperability by abstracting the process of connecting systems away from point of service (POS) developers. When connecting with the EHRs, the POS vendor sends one type of message to the bus, and the bus ensures that the Karos/Initiate/OpenMDM or other client registry is contacted with the appropriate message.

In addition to this, integrated ESB architecture has allowed the Mohawk team to incrementally build services by exposing façade interfaces and building out the service logic at a later time.

Product	Standard	Role	Year
Initiate CR	PIX/PDQv3 HL7v3	CR	2008
Karos Rialto	PIX/PDQv3	CR	2009
NexJ PHR	HL7v3	PR	2010
3M HDD	HL7 CTS 1.2	Terminology	2009
Apelon DTS	N/A	Terminology	2008
SxC SHR	HL7v3	SHR	2010
Deltaware	HL7v3	DIS	2009
Oracle HTB	HL7v3	LIS	2008
HIPAA UAR	ATNA	Audit Rep.	2009
HIPAA CDMS	N/A	PDP	2009

HISTORY
The EHRs RI Timeline

Sept 2007 - Pilot Development Commences
Mar 2008 - First integration with Orion and HTB
Jun 2008 - Version 1.0 demonstrated at COACH eHealth 2008
May 2009– Integration with over 10 vendors accomplished
Jun 2009 - Version 2.0 demonstrated at COACH eHealth 2009
Jun 2010 - Version 3.0 demonstrated at COACH eHealth 2010
Jun 2011—Version 3.0 to be demonstrated at eHealth 2011

DEVELOPMENT
Technology Used

Integration and ESB stack is provided by Microsoft BizTalk Server 2009 and SQL Server 2008. The services for BizTalk are deployed across 5 servers to provide high availability and better performance.

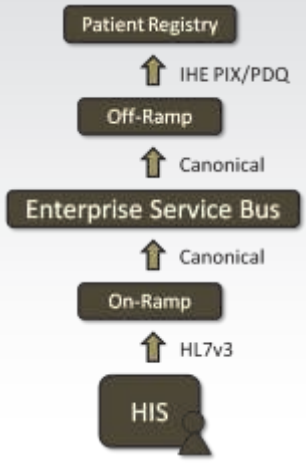
Supporting services such as the MBS are written in a variety of technology stacks however the most popular are .NET/Mono and Java. A variety of database software is also leveraged for our reference implementation work including PostgreSQL, Oracle 10g, and SQL Server 2005/2008.

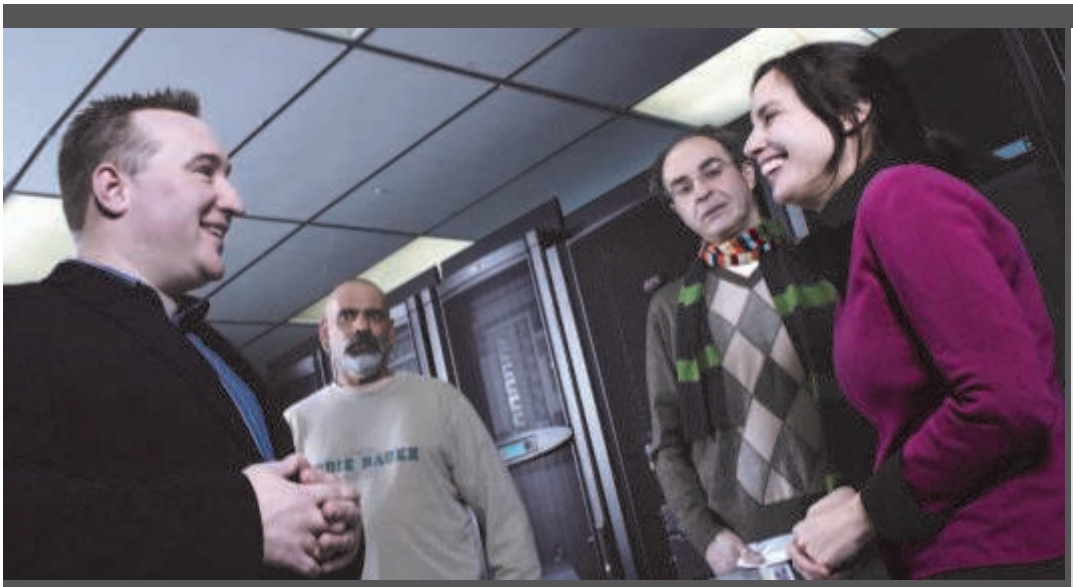
Integrating Legacy Systems

Q: How do you integrate systems that use different standards?

An enterprise service bus never uses the source or destination message formats directly as this tightly couples the system. Rather, a canonical messaging form is used within the bus.

Products don't use the canonical form, rather they implement standards based interfaces. To facilitate integration, all publish operations to the bus are "on-ramped" or transformed using XSL from the solicitor's interface to the canonical form. All subscribers receive messages that are "off-ramped", or transformed using XSL from the canonical form to the target's interface.





EHRs RI Team

Faculty: Duane Bender, Brian Minaji

Lab Staff: Justin Fyfe, Jaspinder Singh

Students: Jose Aleman, Tom Long, Andrew Norgate, Derec Davies, Paul Brown

Next Steps and Upcoming Features

EHRs Record Locator Implementation

The RI team is currently in the design stages of a cross domain, cross jurisdictional EHR record locator which will allow one HIAL to access records from another HIAL in other jurisdictions

Shared Health Record Reference Implementation

Using Everest and PostgreSQL, the RI team is currently developing a completely open source shared health record repository which can be used by integrators to test conformance and interoperability.

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