Welcome to the second issue of TRANSFORM, the e-magazine for the Cloud Best Practices Network that focuses on the powerful business transformation that Cloud computing can enable.

For this issue our goal will be to showcase two key areas: Cloud SOA, the intersection between Cloud designs and the Service Oriented Architecture, and then how this capability might be applied in EHealth.

**Cloud in Healthcare**

To provide this industry focus on Healthcare we’ll be reviewing, and responding to, the recent Cloud strategy published by Canada Health Infoway.

Infoway is the main government body in Canada who sets EHealth technical standards, most notably EHR (Electronic Healthcare Records), and critically the integrations of multiple different systems to achieve Healthcare delivery.

The first white paper from their Emerging Technologies Series, [Cloud Computing in Health](https://cloudbestpractices.net), sets the scene for the role of these integrative Cloud services:

“The original vision for Infoway’s EHRS Blueprint is very well suited to the cloud computing model. Like cloud, the Blueprint is a service oriented architecture (SOA) designed to provide interoperability and information sharing services to a broad spectrum of applications, in a highly scalable manner. Much of the e-health infrastructure, such as: the Health Information Access Layer (HIAL), clinical domain systems, registry services and dedicated shared services (like consent or clinical decision support), can be considered Software as a Service (SaaS) that is offered by a ministry, health region or health care delivery organization.”

This is a visionary and insightful Cloud strategy document, and through this issue of TRANSFORM we’ll set out to provide an industry response to the key points identified, showcasing:

- **Cloud SOA** – How-To implementation models for the SOA architecture methods described, such as linking the Enterprise Service Bus to Community Cloud services for Client and Provider Registries.

- **Community Cloud Blueprints** - Hybrid cloud implementations that meet the needs of an RHA to provide a community service (such as e-referral) utilizing Federated Identity Management (F/IDM) services.

- **Big Data Analytics** - PaaS that can support the analytical needs of reporting, analysis, dashboards, extraction, transformation and load (ETL) and predictive analytics.

- **Cloud 2.0** – Mobile and social enablement of legacy applications and processes.

- **Mobile Device Management**
Cloud SOA - Enabling the Extended Enterprise

What is especially intelligent and important about the paper is that it defines the transformational business benefits of Cloud in Healthcare:

- Reduced IT costs, through consolidation/virtualization of IT services.
- Reduced complexity and increased scalability
- Increased Agility, through collaborative care and mobile & social enablement.
- Reduced IT Sales and Acquisition Cycles
- Increased Measurability and Accountability

There is a keen focus on practical delivery, and especially on the possible new application scenarios it can enable, like appointment brokering and scheduling, E-Referrals, Consent Management and Secure E-mail.

This business focus and these scenarios that offer clear benefit to users are key to the success of Cloud adoption, and highlight the primary characteristics of this new trend.

A key transformation that Cloud SOA can enable is “Enabling the Extended Enterprise” – Better integration between collaborating organizations.

For example consider the concept of EHRs, the backbones of eHealth – Electronic patient data, and ask questions like Where is it stored, and Who owns it?

Traditionally IT is based on a core model where this information would be stored in the corporate data-centre, in a single dedicated database, in the hospital.

However this stems from an era when users were hard-wired to the system via green screen monitors, in the same office. Today we access information from multiple Internet applications including mobile devices from anywhere and everywhere all over the world.

Furthermore implementing one healthcare procedure requires multiple applications, as a patients’ file is moved between the different specialists involved in the treatment.

Not only are there different applications within the hospital, like Laboratory Information Systems, but also there are others outside of the organization too, with "supply chain" partners.

For example in Canada a recent development has been the enablement of pharmacies like Shoppers Drug Mart to dispense flu shots.

What this scenario highlights is that patient care, and the associated information systems, are actually distributed across multiple organizations; our EHR is actually achieved via multiple ‘fragments’ of data about us, each stored in a different system unique to that part of the treatment.

Therefore the primary goal of technology is to unite these into a single logical patient view, and this is Cloud SOA.

The Personal Data Ecosystem

If we extrapolate these trends further and look at the broader long term view of Cloud, we can see the ultimate evolution towards ‘Personal Clouds’.

In short the direction of iPhones et al and consumerization of technology in general will see patients come to ‘own’ and host their own data.

Each person will choose their preferred Cloud provider for use as a “Digital Vault” for storing all of their personal information from family photos through to legal documents like birth certificates and of course then healthcare records.

Technically as well as socially this architecture is ultimately superior to any other as it eliminates all duplicated storage of the information, locating it instead in the one place that all stakeholders would agree on: Under the users control.

Issue 2
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Managing the Canadian Framework for eHealth to Construct a SaaS Cloud Identity

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Software as a Service Within the EHealth Cloud

Based on the Canadian eHealth Architecture Model (see Figure 1.1), the architecture of services delivered to a variety of health professionals is designed as a layered bus based approach. This model, as typified in the associated figure, can be easily constructed in the Software as a Service (SaaS) method, providing each point of service with a software interfacing with data services and databases through multiple layers via the Health Information Access Layer (HIAL) communication bus.

This architecture’s design specifies several common services (as illustrated in Figure 1.2), all of which are required to interface through the HIAL to all data storage locations and services. In particular, these services provide for the enhanced features of an Electronic Health Record (EHR) that are often specified by clinical requirements as well as current laws regarding health information in Ontario (such as privacy and interoperability services).

Within the architecture map, these services are not specifically identified or exploded (as such as the documents specifying operation of a virtual medical record by Health Level 7 International [2]). In providing the common services identified by Canada Health Infoway (CHI), it is important to note that these services at point of service operate to improve clinical practice via informatics support. Said informatics support allows for clinical decision support, alarms and alerts, as well as interoperability with medical devices and other components of the service architecture layers (as is illustrated by the HL7 document above [2]).

Beyond understanding that the layered architecture specifications of the pan-Canadian EHR architecture, and translating this architecture to a SaaS architecture, a clear understanding of the point of service interfaces to the data services is important. For this reason, the operating process is detailed in Figure 1.3 to a limited extent, in which some of the associated actors are detailed at point of activity. Complementing this figure is Figure 1.4, which details the final point of interaction between one actor’s service (built as a software tool), the EHR viewer and the data and other registries.

In the aforementioned paragraphs, the architecture and services are illustrated as identified by CHI, the framework and structural guidance non-profit for the pan-Canadian EHR network. These services, built as software components of an abstraction layer, are manageable as cloud SaaS operationalized components for integration into actor practice in each point of communication with the HIAL communication bus.

Therefore, describing the entire model for EHR architecture with an understanding that the entire architecture is intended to be provided by software as services to integrate with all data systems and registries at the hospital or provider level. From the aforementioned backbone, building a SaaS model is trivial, additionally, providing these services by a distributed cloud model allows for a simplification of the concept across multiple providers and multiple operators.

Virtualized Desktops as a Cloud-based Hospital Informatics Platform

Following the architecture identification mentioned above, building SaaS cloud based system requires a link to the cloud services on each computer accessing the system. At the physician or provider level, this would require extensive support for a complex series of
software and hardware linkages. Building virtualized desktops to provide for a software based solution (and accompanying support) to access the cloud services allows for configurability and modularity as for the device ecosystem at point of care, particularly given the wellspring of mobile computing and hybrid general and fixed purpose computing devices.

In order to develop virtualized desktops, particularly those that offer a SaaS deployment, careful consideration of the services provided and deployment culture will ensure adoption and in healthcare, safe and meaningful use of the equipment. For this reason, adherence to the meaningful use guidelines [3, 4] developed in the United States, as well as advice from clinical partners to develop informatics solutions that capture not only EHR efficiency, but clinical efficiency to improve hospital understanding of the usefulness of Health Information Technology (HIT) services.

With the above in mind, eschewing traditional business intelligence, a more important component of building a cloud based framework in eHealth is the introduction of more complex business intelligence. Said complexity is proposed as a method to integrate cloud-based health IT infrastructure into the framework of health quality and evidence produced by the Ministry of Health and Long Term Care, as a method of improving adoption and ensuring that provincial scientists and policymakers deem HIT as a major benefit to their practice (subsequent institutionalization of the services provided will ensure continued adoption and maintenance). The standard of evidence has yet to be developed, although briefly the points of consideration that should be built while watching the entry of new technologies into the market (and Health Quality Ontario’s push for a greater amount of evidence based medicine contributing the deployment assessments) will follow. In the device market, this evidence primarily consists of utility measures to qualify cost/benefit ratios for incremental deployment adjustments.

For clinical informatics, this appears to be initially constructed by building an indexed searchable database of all elements of care, from text based notes and discharge summaries to vital signs, orders and diagnoses. Once a formal structure for health quality evaluation is established for informatics solutions in the “post-EHR” market, particularly via the expansion of technology assessment units providing cost-effectiveness and cost-utility analyses at both the market and hospital level, we will see a coherent strategy for specific points of business intelligence to be realized. In the interim, focusing in the market criteria displayed in the American Meaningful Use Criteria will ensure that some level of business intelligence functionality is realized prior to the market changes expected in the future.

**Data Abstraction for Health Research and Cost-Effectiveness**

In adopting multiple forms of data interchange protocols, particularly with respect to the production of business intelligence, the need for complete data abstraction through mediated software services/interfaces is a highlight of forward thinking towards effective quality evaluation.

If the blueprint for SaaS based services continues to construct linked abstraction layers connected to services, all querying database layers, this seems like a trivial and constructive method of linking private clouds with the academic sector, through permission optimized restrictions. That said, databases such as the patient administration database at the Institute for Clinical and Evaluative Sciences remains a major contributor to the healthcare quality evaluation from major sources of research and economic modelling. With this in mind, building into the framework of cloud services an access layer capable of pulling anonymous, decision limited data for quality research and economic modelling with regards to coding decisions and complex care parameters will only improve decision making opportunities brought about and performed through the cloud.


[4] O. of the Secretary, “Health information technology: Standards, implementation specifications, and certification criteria for electronic health record...


Roadmap Workshops

The Cloud Best Practices Network offers workshop services to explore and plan these roadmap journeys.

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