Technical Discussion Document: Architectural Framework for New York's Health Information Infrastructure

Table of Contents

1. Purpose

The purpose of this document is to outline an architectural framework and set of principles for the development and implementation of New York's health information infrastructure (NYHII) and in particular the Statewide Health Information Network for New York (SHIN-NY). The SHIN-NY is the lynchpin for achieving interoperable health IT and realizing the expected benefit from health IT in improving health care quality, affordability and outcomes for New Yorkers.

The document is meant to stimulate discussion among the health IT community in New York. HEAL NY Phase 5 Health IT applicants should, however, consider the framework and principles in their RGA response. Adherence to the framework and principles are a part of the application evaluation criteria described in Section 5.

2. Interoperability and Health Information Exchange

Interoperability, as described in section 2, is the term used in this RGA to delineate the complete set of capabilities that must be developed to deliver significant benefits to New Yorkers. Interoperability is necessary for compiling the complete experience of a patient's care and ensuring that such compilation is accessible to clinicians as the patient moves through various healthcare settings. This record will support clinicians in making fact-based decisions, so that medical errors and redundant tests can be reduced and care coordination improved. Interoperability is critical to cost-effective, timely, standardized and valid data collection and reporting for quality measurement, population health improvement, biosurveillance, and clinical research. Interoperability is also necessary for patients to have access to their personal health information that is portable and not tethered to a particular payer or provider. Interoperability is essential to realizing the expected benefit of health IT to improve the quality and efficiency of care in New York.

Specifically, interoperability is the ability to exchange patient health information among disparate clinicians, other authorized entities and patients using widely divergent systems in real time while ensuring security, privacy and other protections. Health information exchange (HIE) is central to achieving interoperability. HIE can be thought of as any other information exchange: conversation, fax, passing papers, snail mail, email, and Web portals all qualify as mediums of information exchange. In this interoperability context, HIE uses specific types of health information, e.g., patient demographic information, lab results, prescriptions, reports, procedures, quality and population health metrics, etc. In technical terms, HIE supports patient-centered digital representations based on emerging standards connected though electronic networks.

In NYHII, the expectation is that there will not be 'a single Exchange', physical or virtual. There will not be a physical Exchange such as the noisy trading floors in New York or an open market like those set up by farmers or in state fairs. There also will not be a single 'virtual' Exchange like eBay. The SHIN-NY, for example, will be the sum of interoperable regional HIEs governed by RHIOs, and NHIN is the sum of many interoperable state HIEs such as SHIN-NY. This is accomplished by establishing policies and agreements that enable virtually all authorized parties to use the HIE at each level. The vision for the clinician or other authorized user is to experience one big exchange. In reality there are many health care organizations and systems participating in HIE services and their ability to coordinate creates the illusion of a central exchange, simplifying the clinician experience. For example, a physician desiring the Rx history of a patient should only need to 'press a button' to fulfill the request. Underneath, the Rx service may have to traverse many HIEs to obtain the information sought (Figure 1).

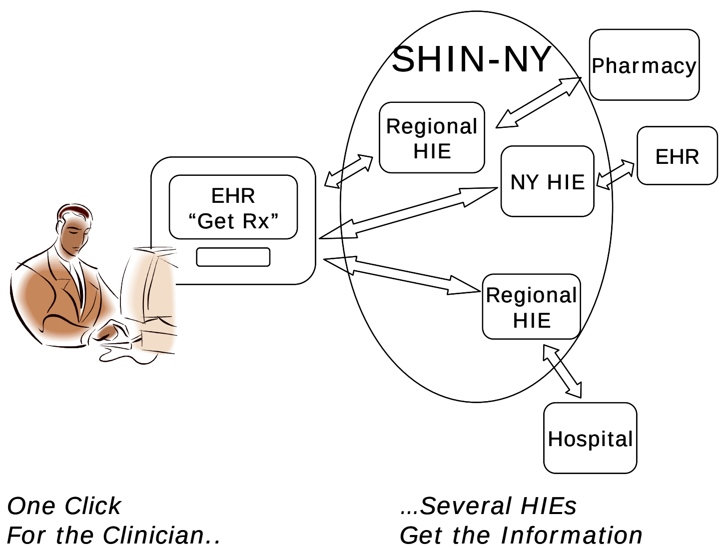

Figure 1

3. <u>Integrated Vision: Achieving Benefits from Health IT</u>

There is widespread agreement and evidence that better health information availability, and vastly improved uses of it, would dramatically improve health outcomes and reduce health care costs. The technological infrastructure and capacity that would make health information available and useful is underway and in early stages of development. The Federal government has called for the development of this infrastructure – the nationwide health information network (NHIN). New York is providing leadership and investing substantial funds into the development and implementation of a health information infrastructure in New York, as discussed in Section 2.

The successful development and implementation of New York's health information infrastructure will be defined by how beneficial health information is in improving quality, reducing health care costs and improving health outcomes. Achieving these benefits is dependent on much more than just technology. The story below exemplifies this point.

> *Suppose it was discovered that live music dramatically improved health outcomes. New York rallies and demands live music in every health interaction. However, the musical abilities among our health professionals are limited. The health care community comes up with a technological solution: "we will put a piano in every doctor's office." That should solve the problem. But we know that pianos will not solve the problem alone, because, as any musician will tell you, the music is not in the piano.*

There is some hyperbole in this story but the essential characteristics are analogous. The benefit is the music or in the information. Electronic health records (EHRs), for example, are essential but not enough to ensure effective use of information and improved health for New Yorkers. An environment must be created and substantial efforts made to 'get the music from the piano' or utilize the information and enable clinicians to learn how to consistently realize the benefits from vastly improved availability of health information.

There are two key overarching strategies to achieving benefits from NYHII: (1) combining organizational, clinical and technical infrastructures and (2) advancing cross-sectional interoperability, as explained and depicted in Figure 1 of section 2.

3.1 Combining Technical, Clinical and Organizational Infrastructures

The definition of interoperability includes much more than technical interoperability of information systems; it is people and policies or organizational interoperability, also.

Information exchanges, like the regional HIEs that will constitute SHIN-NY, use the term liquidity to express the level of interoperability or rate of flow of assets through the exchange. Exchanges are characterized as very liquid when almost all uses succeed (e. g., finding clinical information about a patient to inform medical decisions; receiving a drug-drug interaction alert). Conversely, in an illiquid exchange a large number of uses may fail (e. g. not finding current and/or complete medication profiles for patients).

A high level of liquidity for the health information flowing through SHIN-NY is essential. The key to generating liquidity in any exchange is the belief on the part of stakeholders that uses of the exchange will succeed and be beneficial and that, in rare cases of problems, the stakeholders will be protected and problems solved. This is as much a function of trust as technology or clinical participation, and is achieved through policy and governance. Thus, NYHII and SHIN-NY must emerge as the result from three intertwined capabilities:

- <u>Technical:</u> Technology to enable technical interoperability of health information.

- <u>Clinical:</u> Clinician adoption to attract sufficient demand and supply to increase the likelihood of success and delivery of benefits to the participants.

- <u>Organizational:</u> Governance that establishes trust by assuring stakeholders that most of their usage will succeed and issues will be resolved reasonably.

All three components – organizational, clinical and technical - must dovetail, or co-evolve so they can be coordinated and addressed together. These efforts are essential for the NYHII to succeed in achieving a successful rate of interoperability or creating 'health information liquidity'.

RHIOS are important in this context. RHIOs, working with other RHIOs, and governments and other organizations, must create an environment that assures effective HIE both organizationally and technically through governance. RHIO participants must trust that the underlying infrastructure is reliable and scalable and that the RHIO will address instances where things go wrong, e.g., a possible security breach. This implies a highly reliable, scalable and effective technical implementation through health information service provider and vendor partners, a strong and effective governance process and constant efforts to promote the value of the exchange, fostering widespread clinical use. Efforts to achieve the right combination of these three aspects have the highest probability of generating 'health information liquidity', where health information is reaching the right place at the right time. An environment with 'health information liquidity', in turn, has the highest probability of generating benefits to New Yorkers with respect to improved health outcomes, lower costs and better quality of care.

3.2 Cross-Sectional Interoperability

The challenge in implementing NYHII and SHIN-NY is made more difficult in that each of the three elements of a functioning HIE: demand, supply and the infrastructure, exist only in part or not at all today. The cross-sectional interoperability approach addresses this by implementing capabilities in limited amounts that include all three technical building blocks (SHIN-NY, CIS, 3Cs) described and depicted in Section 2.

Systems implementing cross-sectional interoperability have the following characteristics:

- **Benefit Right from the Start:** There must be real value for clinicians from the beginning. It is not as critical that it be 'easy to use', though the less difficult the better. It is more critical that the benefits are real and proportional to the efforts to obtain and sustain them.

- **Community-based Adoption:** Health IT tools must be readily available and integrated deeply into the practices of a community of users to realize benefit internal to the community over time. There should be a tool for every user, along with process improvement, quality improvement education and constant use in real practice situations leading to clinical adoption.

- **Integrating Demand and Supply:** Efforts must be started immediately to educate potential users of the SHIN-NY about the early benefits to 'jump start' uses of SHIN-NY until there is enough experience and visibility to sustain usage.

These three characteristics support the "cross-sectional" interoperability approach described in Section 2. A complete cross section can be designed to provide real benefit as soon as possible. One goal of the clinical investment priorities and use cases is to identify opportunities amenable to this approach. In this way a clinician can begin to derive benefits from these 'cross-sections' without having to wait for an entire health information exchange component to be completed and available via the SHIN-NY. Like any infrastructure project, be it roads, water treatment or information, limited efforts can provide value by integrating demand and supply through the infrastructure. For example, a small number of well chosen roads will enable some transportation and commerce that was not possible prior to their construction.

4. How do we build NYHII and SHIN-NY?

As summarized above, there are many considerations in building NYHII: technical, organizational, clinical. They are not entirely separable, but the focus here will be on the technical with reference to the others as needed.

The essential characteristics of New York's health care environment must be understood when creating NYHII and SHIN-NY. Then, a set of principles processes and structures can be defined to guide the detailed design and implementation of the NYHII and SHIN-NY. Together, these principles, processes and structures define the architecture for NYHII, and in particular SHIN-NY.

4.1 What are the critical assumptions about New York's health care environment?

The ultimate environment in New York will be one of very large scale in most critical dimensions:

- Number of clinical information users (tens of millions)
- Number of clinicians desiring simultaneous access to various parts of the system (hundreds of thousands to millions)
- Variety of users (doctors, nurses, New Yorkers, public health authorities)
- Variety of interactions between clinicians/systems (doctor-patient, doctor-doctor, doctor-provider, provider-patient, New Yorkers-Govt),
- Amount of information (many petabytes)
- Number of health care organizations/computing systems involved (tens to hundreds of thousands).
- Number of evolving data and technical standards (In its 1st year, HITSP has developed three sets of Interoperability Specifications that included 30 consensus standards).

The requirement to support very large-scale environments leads to two critical assumptions that lead directly to principles for the overall technical architecture: the environment will be very heterogeneous and continuous changing.

The overall environment will be extremely heterogeneous in nature at the start. Virtually every kind of computer, many different types of software, many different types of health care organizations and clinical information users with different levels of skill, etc., need to be part of the environment. It must be practical to integrate existing environments into the new environment at reasonable cost/effort. In words that have been used by many working on health IT, 'rip and replace' is not an option.

The overall environment will also be one of continuous changes at the software, hardware, network, and user level. New technology advances are rapidly being introduced in outpatient, inpatient, residential and home care environments. Home use is accelerating as telemedicine tools and monitoring devices gain the ability to connect to a network and can then participate in SHIN-NY. Everything from blood glucose monitors to multifunction machines that measure weight, blood pressure, pulse and more are being 'network-enabled', and the value of SHIN-NY will dramatically increase if these new technologies can be quickly integrated.

Heterogeneity and change will be constant and flexibility to accommodate unanticipated components and retire existing components without significant disruption to the overall system will be essential. The 'system' is never down.

We have a good example of this today. It's the Internet.

4.2 What is architecture in this context?

Architecture in general is a set of principles, structures and processes used to guide the design and construction of systems given a set of environmental assumptions. In this case, the architecture will guide the design and construction of NYHII and in particular, SHIN-NY, in the environmental context described above.

Architecture for a complex environment and system is organized at different levels or layers. Architectural layers contain boundaries used to define interfaces and isolate system components as well as provide principles and processes used to guide design of dependent layers.

At each layer, architecture needs to be as concise as possible and yet still descriptive enough to answer all the questions of the next level of refinement. For example, the Constitution of the United States is the entire architecture of our government and the resulting systems that still run the country today. The whole thing fits in a few pages, a bit more if you include all of the subsequent amendments. The laws and cases that have resulted from that Constitution fill libraries, and are full of contradictions and messy corners. Local courts don't worry directly about the Constitution, but the principles drive all the users and provide ultimate resolution if necessary.

This document will describe the foundation layer architecture, and provide general comments on upper levels but will not provide detailed specifications. The NYHII foundation layer technical architecture is analogous to the Constitution; respondents should use the guidance provided to develop their specific technical architecture.

4.3 NYHII Foundation Layer Technical Architecture (PDLBA)

The NYHII foundation layer technical architecture is based on the environmental assumptions of heterogeneity and continuous change described above. To be successful in this environment, one essential concept will form the basis for the NYHII foundation layer technical architecture. For lack of a better term, it will be labeled a 'protocol driven, late binding architecture' or PDLBA. A PDLBA is structured around groups of **protocols** governing the function of the system. As importantly, these protocols attempt to define the system at the highest level of abstraction possible. In non-technical terms, one can sum up a successful PDLBA implementation as an exercise in delayed gratification: a system that never makes a decision now if it can wait until it has more information about the actual needs to be fulfilled. A second critical requirement is that the protocols be 'open'. This is more easily defined by stating the inverse: the protocols must not be proprietary. This approach is the most effective known for addressing the critical environmental challenges of heterogeneity and continuous change in a very large-scale system.

Here are contrasting examples to help clarify the PDLBA approach and its benefits. Consider the difference between the Windows or MAC operating system and the Internet as platforms for running applications. Applications written specifically for the Windows or MAC OS are not as flexible as those written to run over the Internet. One cannot substitute the PC hardware for MAC hardware or vice versa. The same can be said for the software.

In contrast, an application written to run on the standard Internet (and WWW) protocols will generally continue to work correctly even if all the hardware and software is changed as long as it continues to implement the same protocols. Any computer that implements the appropriate protocol can connect to anything else. This also means that any device can replace any other device as long as it implements the identical protocol. You don't know what type of machine is responding to you when you connect to Google or any other web site. That machine or machines can be replaced or changed at any time without effect if the new machine implements the protocol of the old machine. On the other end, you can replace a PC with a MAC and still connect to Google. In more technical terms, the Windows/MAC OS platforms implement a relatively **early binding** architecture vs. the Internet that implements a relatively **late binding** architecture. One of the primary objectives of the PDLBA is to push towards 'late binding' as much as possible.

To understand proprietary vs. open protocols, consider the difference today between the use of a mobile phone in the US on a particular US phone network and the use of a computer or, more and more, a phone, on the Internet.[1] Mobile phones in the US are hard wired to the networks: a Verizon phone is not guaranteed to work on any other network such as Sprint, AT&T, T-mobile, etc., even if the phone is identical in basic hardware and software, and *even if the networks are defined by standard protocols.* In this case the network vendors implement their own proprietary variations around the standard protocols to control the use of devices on their networks.

[1] For an overview of this topic see: David D. Clark, "Interoperation, Open Interfaces, and Protocol Architecture" The Unpredictable Certainty: White Papers, National Academies Press (1997)

Compare this to the Internet, where protocols are designed and published by groups such as the IETF (Internet Engineering Task Force: http://www.ietf.org/) and the W3C (World Wide Web Consortium: http://www.w3.org/). Internet protocols tend to be stable and widely adopted, with no particular vendor or other institution able to control them. One result is that many of the benefits of late binding prevail and interoperability and flexibility are reasonably good. In more technical terms, the US mobile phone networks implement **proprietary** protocols while the Internet implements **open** protocols. The objective of the PDLBA is to push towards open protocols as much as possible.

What does a PDBLA look like in practice? To be protocol driven requires…protocol.

4.4 Common Health Information Exchange Protocol (CHIxP)

Protocols will be the linchpin of NYHII and SHIN-NY. They will provide a common basis for interoperability: Common Health Information Exchange Protocols (CHIxP). While layered diagrams (such as Figure 1 of section 2) are useful in describing the hierarchy of the system, a PDLBA looks like a hub and spoke system from a communications perspective (Figure 2). Every core HIE service talks through the CHIxP (with an optional adapter layer for external/legacy environments) to every other core HIE service it requires to fulfill its function. The result is that every interaction is dependent on the CHIxP. The need for agreement and widespread adoption and implementation of the CHIxP is crucial for NYHII and SHIN-NY to be successful. The simpler and smaller the CHIxP is, the better the chances of success, because it will be easier to implement successfully on a widespread basis. It is essential for the CHIxP to be 'open' to avoid ceding control to a particular vendor or other institution in the health care environment of New York.

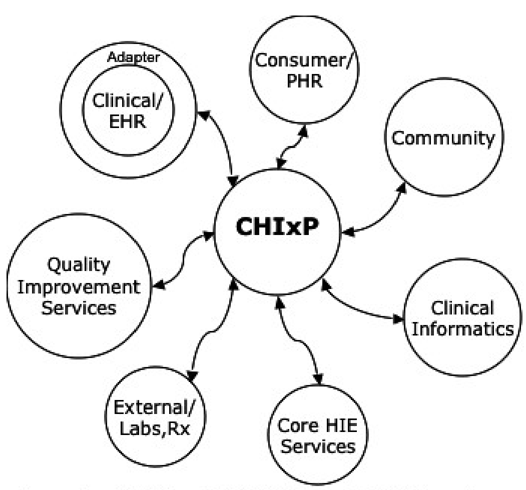

Figure 2 - *NYHII and SHIN-NY use of CHIxP creates a hub and spoke communications architecture*

The goal is to create a CHIxP that has important function that makes the overall vision more easily achieved while keeping it as simple and succinct as possible. There are many examples of this kind of system architecture, from the Internet to cellular structures in biology. The Gartner Group's "Summary of the NHIN Prototype Architecture Contracts" makes explicit reference to the need to use this 'narrow waist' architecture.[2] As a more concrete example, many building block sets exhibit this capability. In Figure 3 are some pictures of objects built from K'nex (www.knex.com). There are a few simple connectors and many components that can be linked by these connectors. Children small and large are able to build complex and innovative structures by using a large number of simple connectors and components. The analogy with the overall system envisioned here is strong: the 'set of connectors' are the CHIxP, and the components are the system components or core HIE services, as defined in the Summary of The NHIN Prototype Architecture Contracts (footnote 2). Even if the CHIxP protocol is small, large numbers of CHIxP connections with large numbers of system components can create complex and innovative structures, as has been the case with the Internet.

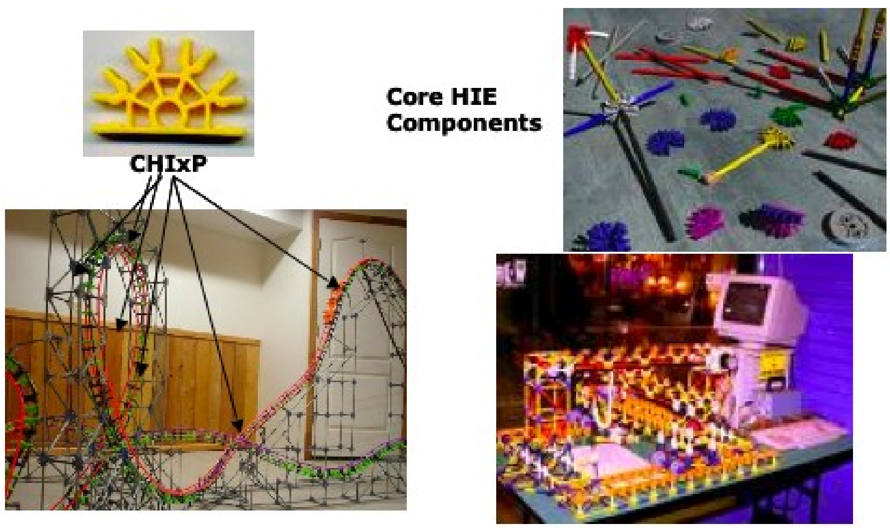

Figure 3 - *Complexity results from interconnecting large numbers of simple objects. With a small, well designed set of connectors and a variety of components very complex structures can be assembled, in this case by young children (roller coaster on left). A powerful construction environment often yields surprising structures (a functional graphic plotter on the right) as creativity is unleashed.*

[2] Summary of the NHIN Prototype Architecture Contracts, Gartner Group, page 10, available at:. For one of the best explanations of the general importance of this approach, Also see: The End Of The End-To-End Argument?. Dave Reed is one of the original Internet architects and an excellent writer.

5. Building on the PDLBA Foundation

The use cases begin to specify the desired results and, through iteration and refinement among grantees, will become the blue print through which HIE implementation occurs. There are many approaches to implementation that can yield successful systems. The goal of this section is not to give specific advice as to the approach. It is to explain how the PDBLA foundation relates to the architectural choices used to guide a particular implementation. Currently prevalent architectural patterns are used as concrete examples.

5.1 PDBLA as a Foundational or Contextual, Architecture

Many architectural approaches can produce good or bad systems depending on their instantiation in a given system. Recall the US mobile phone networks example: though the networks are largely protocol driven and even fairly late bound, the proprietary nature of critical portions of the protocols has a dramatic effect on the function of the resulting system. Judgment as to whether this actual system is 'better' or 'worse' requires a contextual architecture. In the context of the PDLBA described above, the US mobile phone networks would be judged 'worse' than another network that enables the use of any phone on any network (as do many international phone networks). The network vendors undoubtedly have a different contextual architecture that judges this system 'better'.

5.2 Stateless vs. Stateful Architecture

An important issue when constructing large scale, heterogeneous systems such as NYHII and SHIN-NY is stateless vs. stateful architectures. In non-technical terms, stateless architectures let one 'cut the network cable' at any point with no ill effects. More precisely, stateful architectures are allowed to remember things about ongoing interactions, much the way people remember an ongoing conversation, and can build complex, layered discussions through incremental dialog. Stateless architectures forbid any memory between interactions; it is as if people holding a conversation cannot remember what they just said; each interaction would need to be self-contained, recapitulating all necessary information. It would seem very strange to hold such a conversation among people.

Similarly, in networked computing systems, stateless interactions require much more dialog over the network and seem intuitively inefficient. If a physician is using an interoperable EHR that is retrieving information through many HIEs in many places, wouldn't it be logical to avoid the retransmission of information each time another interaction is required? The simple answer is "yes", but experience has generally shown that systems of this scale exhibit complex, emergent behaviors, and that in this case the emergent behaviors often cause difficulties far greater than the seeming inefficiency of a stateless architecture. For example, in extremely diverse environments such as NYHII and SHIN-NY, it is difficult and resource-intensive to maintain the state of all transaction across the HIEs. In the context of the PDBLA, stateless architectures are inherently later bound; thus, there is a strong bias in favor of a stateless architecture.

5.3 SOA

One of the highest profile architectural patterns in use today is the Service-Oriented Architecture or SOA (http://en.wikipedia.org/wiki/Service-oriented_architecture). SOA can be implemented using a variety of approaches, with the combination of SOAP (Simple Object Access Protocol – now morphing to Service Oriented Architecture Protocol), XML (Extensible Markup Language) and WDSL (Web Services Description Language) currently the most popular. It is important to emphasize the need for a contextual architecture to render consistent judgment about the merits of a particular SOA implementation of the use cases, because SOA implementations can vary widely, even using different sub-architectural approaches (such as Representational State Transfer - REST - http://en.wikipedia.org/wiki/Representational_State_Transfer) in addition to different implementation approaches. The 'acronym soup' can become overwhelming. A completed system can be described as an SOA but may have more or less of the desirable characteristics of the PDLBA above.

For example, an MPI service can be implemented using SOA principles by providing web services that enable use of the MPI service. However, if those web services expose a particular representation, such as an ID specific to a given implementation of an MPI, then it is still relatively early bound compared to an implementation that uses a generic Record Locator Service whose implementation can be supported by multiple MPI services. The PDBLA would judge the latter, later bound approach superior.

5.4 Distribution

Distribution architecture also commands significant attention from New York's health IT community. Many discussions are conducted over the 'centralized' vs. 'decentralized' or 'federated' vs. 'hybrid' approaches. All three of these models are under consideration by RHIOs in New York. This level of architecture is similar to that of SOA: each variation can produce better or worse results when judged through the PDLBA lens. Further, this is an area where the definitions are often imprecise, causing more difficulties. Most important for the HEAL NY

Phase 5 Grant Program is the effective use of any or all variants of distribution architecture to push for the PDLBA goals: late binding and open protocols.

5.5 Web 2.0

In the same vein, 'Web 2.0', often used synonymously with the AJAX architecture (http://en.wikipedia.org/wiki/Ajax), is an independent issue, not inherently good or bad. There are trade-offs, in particular between more 'client-side excitement' and more dependence on client software (e. g. browser add-ins such as flash or javascript). Client software dependence can be thought of as an 'earlier binding': different browsers and versions of the same browser cannot be substituted and flexibility suffers; older machines may not be able to support the computing necessary and scalability suffers. An approach more tightly coupled, or dependent, on specific components is 'earlier bound' and rates lower in the PDLBA context. The advantages must clearly outweigh the negatives to make it worthwhile in the PDBLA context.

6. Where to begin – building sharp tools

One of the challenges of building large scale infrastructure is the recursive problem: there is no infrastructure for the infrastructure. Big construction projects expend significant resources on scaffolding: temporary support structures to improve the productivity in creating the permanent structure. When the Empire State Building was constructed, an entire elevator bank was built solely to support the construction. It may seem very wasteful and expensive, but in fact saved time and money.

Fred Brook's The Mythical Man Month describes the development of complex software, and strongly advocates "building sharp tools", the scaffolding of information systems. Sharp tools are an enormous benefit when building new infrastructure. Consider the Connecting New Yorkers to Clinicians use case as an example of the challenge of building infrastructure for the infrastructure. Ideally, the implementation of this use case would be predicated on the availability of CHIxP, and would integrate medications from various sources via the NYHII and SHIN-NY, making them available to New Yorkers using CHIxP. But CHIxP is not yet available and may change. There will be many different information formats and system interfaces that need to be integrated. One could wait until CHIxP is available to begin, but a superior approach would be to develop an isomorphic or common protocol. For instance, to enable the use of a common protocol one could build a web services interface to the CHIxP, so that CHIxP protocols do not get bound into applications, effectively creating a CHIxP dictionary. An application 'looks up' the CHIxP protocol for a specific request rather than embedding the protocol directly in the application. If the CHIxP protocol changes only in form (e. g., to conform to a NY or national standard), applications are unaffected.

Another sharp tool, monitoring, can be embedded in HIE implementations by taking advantage of capabilities that enable a level of 'self-awareness' so that running HIE systems can be queried and paused much like an online database (e. g. Microsoft's '.NET' and most Java environments have some support for this approach). Ideally, a running system can be examined and paused at any moment, so that if there is a problem, the HIE can report precisely on the health information it is processing at that moment. This helps tame the 'combinatorial explosion' of interactions when integrating many information sources through a hub like the CHIxP.[3] Each new integration of an information source (such as a new regional HIE) through CHixP adds many more than one new possible interaction through a HIE using CHIxP.

7. Relationship to NHIN and Developing HIE Standards

Developing a strategy for addressing the many existing and developing standards that impact HIE requires first assessing the current standards environment and clearly defining the objectives of the NYHII regarding these standards. Standards are an important element of interoperability, and are necessary, but not sufficient to achieve HIE. Paradoxically, too many standards impede interoperability. Too much dependence on any one standard impedes future interoperability when the standard is changed or extended (most EHRs have difficulty adapting to new information sources beyond the application).

SHIN-NY will be a part of the emerging NHIN. Ultimately, the NHIN will be the sum of the various interoperable networks such as SHIN-NY. It is more accurate to say that the NHIN is the result of the implementation and interoperability of SHIN-NY and other interoperable HIEs, which are then labeled 'NHIEs' or NHIN HIEs. NHIEs must adhere to current and evolving requirements established primarily through the Office of the National Coordinator for Health IT (ONC). SHIN-NY aims to create short term value for New Yorkers through statewide efforts and increase long term value for New Yorkers by being well integrated into the NHIN. Therefore, the objective of SHIN-NY and NYHII is to be consistent with and build upon the NHIN principles and standards by working closely with ONC and influencing its overall development.

[3] If the interactions are symmetric, the total number of interactions for n systems is n(n-1)/2. Adding one more system adds n more interactions, so adding 1 system to a network of 10 adds 11 new interactions, whereas adding 1 more system to a network of 1000 systems adds 1001 new interactions. This is a classic scalability issue.

7.1 Current Standards Environment

There are a number of efforts taking place to adopt and deploy standards and it is difficult to gain a perspective on where these efforts will intersect the NYHII and SHIN-NY. There is an old one-liner: "The nice thing about standards is that there are so many to choose from". There are two issues underlying the difficulty. First, the standards are still developing. The HITSP is the current national effort working to create and promulgate critical standards for HIE. HITSP has made, and will continue to make, recommendations to various groups including HHS that can then take policy action leading to large-scale adoption.

The second issue is that most standards have emerged over time in response to needs of the practices (e. g. the ICD-9 and ICD-10, SNOMED and CPT standards, and the newer HL-7 and NCPDP standards among many others). Many of these standards overlap and create inconsistencies, and where there are gaps that need to be filled it is not clear which standard to extend to address those gaps. This is why standards need to be harmonized or integrated in order to understand their intersection with NYHII and SHIN-NY. Harmonization is essential, due to the widespread use of many standards in various areas of practice. All standards are required to be consistent with current and emerging federal standards, as recognized by the Secretary of HHS.

7.2 NYHII and SHIN-NY Standards Strategy

In order to make progress now, NYHII and SHIN-NY must address the harmonization issues. The most effective approach is to use a combination of process and technology to manage the integration of standards into NYHII and SHIN-NY. The technology approach uses a layer of protocol to isolate NYHII and SHIN-NY and its users from the evolving standards. This mapping protocol is then implemented using adaptors to the various standards as necessary. In this manner the messy nature of the standards interface is confined to these adaptor components. This strategy also ensures that particular standards are not embedded into NYHII and SHIN-NY.

The process approach monitors and participates in the HITSP process and other important standards efforts. It is also important to monitor the adoption of standards 'in the trenches'. Widespread use in practice is perhaps the most important element driving the need to integrate a standard into NYHII and SHIN-NY. A capacity to implement adapters to integrate standards and to keep these adapters updated as standards evolve is also important. Lastly, a governance process must be instituted to manage these resources, decide when a particular standard requires support from NYHII and SHIN-NY and allocate the resources necessary to accomplish this.