

Towards a Health-Care Business Process Reference Model

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1 Abstract

The structure of the health care industry is in flux. In seeking more cost-effective solutions, enterprises are constantly experimenting with different business models and trying various combinations of roles: risk holder, care provider, plan manager, and plan administrator. Health plans are also becoming more complex. Comprehensive plans often aggregate smaller plans, each covering a different category of benefits with a different business model for providing and administering care. From both a business and information systems perspective, the result is expensive chaos.

Part of the problem is that there is little standardization of health care business processes and thus little standardization of participant roles and interactions within these processes. The existing HIPAA standards focus on the dialog between health care providers and payers, leaving the interactions between other roles to be negotiated and customized for each business arrangement. The lack of business process standards drives up the cost of providing health care and presents a barrier to the evolution of the health care system as a whole.

Fortunately, there is some natural order in this chaos: the roles played within each health care process remain relatively consistent despite the endless organizational variations. Standardizing the business process down to these roles and their interactions will enable different and changing business models without the added cost of developing custom interfaces. Standardization will also make it possible to track and report the status of transactions as they traverse the various roles, setting the stage for improved response times and a corresponding improvement in the quality of care.

This paper illustrates this approach using simplified examples drawn from the financial aspects of health care. Its purpose is to share the concept as a step towards building a consensus in the health care community and developing a full-scale health care business process reference model.

2 Motivation

The lack of standardization in definitions of roles and their interactions is costly. When two interacting roles are played by different legal entities their interactions must be defined on both a contractual and technical basis, with contracts driving many of the technical requirements. The existing HIPAA standards focus only on the dialog between two major roles, providers and payers, leaving the interactions between other roles to be negotiated and customized for each business arrangement. This is logical, since HIPAA was intended to “support the electronic exchange of administrative and financial health care transactions primarily between health care providers and plans.”¹ But even where HIPAA-specified interfaces are in use, they are almost always extended by additional agreements between the parties – agreements that define both the data and business rules surrounding the business interactions.^{2 3} In practice, nearly every interface between every pair of parties today needs to be individually specified

and implemented. This drives up the cost of providing health care and presents a barrier to the evolution of the health care system as a whole.

Sidebar: HIPAA EDI Transactions

At the time of publication there are eight standardized transaction sets and two additional sets pending approval.⁴ These transaction sets are commonly referred to by their EDI X12N transaction numbers. Some of the more common transaction sets are:

EDI X12N Number	Transaction Set Description
837	Claims or equivalent encounter information.
835	Payment and remittance Advice
270-271	Eligibility inquiry and response
278	Prior authorization and referral
276-277	Claim status inquiry and response

Fortunately, there is some natural order in this chaos – order that can be leveraged to manage these costs while at the same time preserving needed flexibility. This order is found in the relatively consistent roles that are played within each health care business process despite the endless organizational variations in who plays each role. For example, in every instance of a health care claim, care is given and claims are prepared, submitted, routed, accepted, adjudicated, and paid (at least in the sunny-day scenario). What changes from business model to business model are the role assignments - which business entities play which roles. And while occasionally some new roles do emerge (generally new intermediaries assuming portions of administrative responsibilities), these emerging roles generally result from the subdivision of an existing role.

This relative stability of roles and their interactions within each business process presents a significant opportunity. A business process reference model that standardizes the roles and the interactions between them will enable different and changing business models without entailing the added cost of negotiating new inter-company interactions and implementing their supporting system interfaces. The reference model will further allow modularized systems to be developed that can provide flexible support for individual roles. This will reduce the administrative cost of providing health care services while preserving the flexibility to evolve the related business structures.

Creating a reference model for the business processes also makes it possible to standardize the tracking and reporting of health care transactions as they progress from role to role and business to business. Standardized reporting provides the visibility required to manage overall transaction response times and enables the identification of languishing transactions so that they can be driven towards a more timely resolution.

This paper illustrates this approach using simplified examples drawn from the financial aspects of health care. It examines the business process and roles involved in the settling of a health care claim, and illustrates the variety of ways in which the roles can be played by different parties. The interactions between these roles are examined with an eye toward standardizing their corresponding technical interfaces. The claim is that these technical interfaces are appropriate regardless of whether the role interactions they support are internal within an enterprise or external between enterprises. We also show how the abstraction of certain business functions into business services further enhances the flexibility of the business processes and how the monitoring of process execution can reduce administrative costs.

The purpose of this paper is to share this concept and solicit feedback. We are interested in building interest across the health care community to carry this work forward and develop a full-scale health-care reference architecture. Towards this end, we invite your comments – and your participation at www.healthcarereferencearchitecture.org.

3 Business Process Reference Models and Reference Architectures

A reference model is a division of functionality together with a data flow between the pieces.⁵ In this paper we look at the division of functionality and data flow in health care business processes. In discussing the same notion Harmon uses different terminology, calling it a process architecture.⁶ This is an area that has long been neglected in IT but is becoming a critical success factor in achieving cost and flexibility objectives.⁷ The direction advocated in this paper is part of the total architecture approach described in *Implementing SOA: Total Architecture in Practice*.⁸

In contrast, a reference architecture is a mapping of a reference model onto software elements (that cooperatively implement the functionality defined in the reference model) and the data flows between them. What we are highlighting in this paper are the benefits of a *partial mapping* in this direction. We suggest is that there is significant benefit in defining both the reference model and standardizing the logical (not physical) definition of data flow interfaces and their related data structures *without defining which software elements will implement those interfaces*.

4 Challenges

4.1 The Ever-Changing Relationships between Roles and Business Entities

The roles played by different parties in the health care world are evolving. Figure 1 shows the roles typically associated with a provider and a payer with respect to providing a service and settling the resulting health care claim. While historically there have been only two participants in this process, in today's world there are often many more. Providers utilize services to prepare their claims, and groups of providers form networks that submit claims on their behalf. Complicating matters even further, the claims preparers work for many service providers, and claims submitters submit claims on behalf of many providers through many claims preparers.

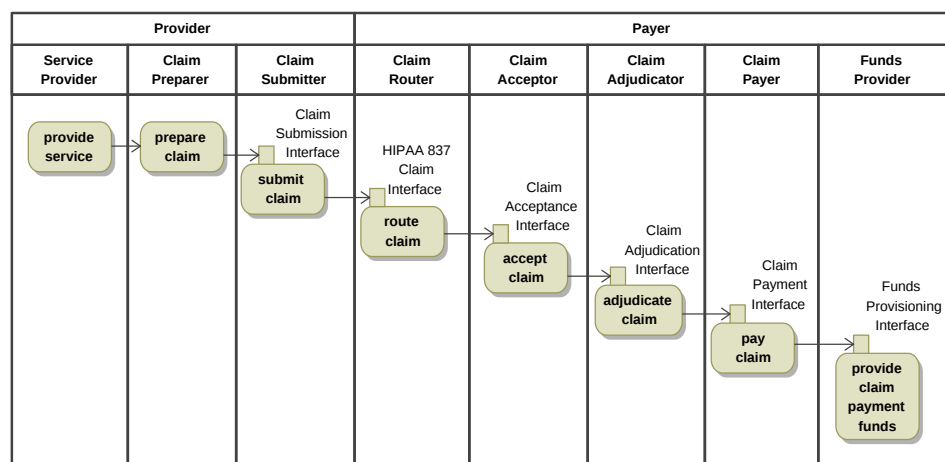


Figure 1: Traditional Provider-Payer Roles and Interfaces

On the payer side, similar splits of responsibility can be found. Some insurance “nameplates” have a single point of entry for submitting claims, then route the claims to different claims acceptors and adjudicators. Other nameplates outsource some or all of these responsibilities. Some insurers write checks against accounts in traditional banks, while others have, themselves, become banks. Even the risk holder, the entity providing the payment funds, might be an insurance company or it might be an employer. In a shared-risk situation, there may even be more than one entity providing the funds, or a reinsurer involved.

4.2 Lack of Standard Interfaces between Roles

In examining the interactions between the roles in this process, we find that there is only one currently standardized interface – the HIPAA 837 that corresponds to the traditional boundary between the provider and the insurer. But even here the interface is not truly standardized. The HIPAA transaction specifications are not complete either with respect to the mechanics of communication or the information content. The parties involved must negotiate the mechanics of transport and the security surrounding the interactions. In addition, the parties almost always have their own rules regarding the

use of this interface and the data values carried in the messages. As a result, it is not unusual for a party to have a 100-page companion document for each HIPAA interface specifying its specific usage rules.^{2 3}

For all other role interactions each pair of parties must develop rules and specifications for each interface. In the absence of standards, the data structures passed back and forth are often loosely based on existing system interfaces. These data structures typically contain HIPAA-required information with additional data to support the business dialog between the parties.

Most of the information added at these interfaces is for the purpose of identifying the parties playing the various business roles managing the routing of claims between the roles. If a `Claim Acceptor` receives a claim from a `Claim Router` and forwards it to the `Claim Adjudicator`, how is the `Claim Adjudicator` to know where to send the response? The identities of the intermediaries involved in processing the claim must somehow be known so that the response can be appropriately routed. Many of the rules regarding the use of interfaces simply establish conventions that indicate the various parties, either directly or inferentially.

4.3 Replicated Functionality with Inconsistent Business Rules

Another cost driver in the health care community is the recurring need for the same logical function at various points both within a given business process and across different business processes. Figure 2 shows a number of places where member eligibility can be checked and services priced. Eligibility checking is also provided as a stand-alone business process, as when a HIPAA 270 Eligibility Check is submitted. Despite the similarity in functional need in different places, today's implementations often replicate the function and its business rules with partial and inconsistent implementations, resulting in increased maintenance costs.

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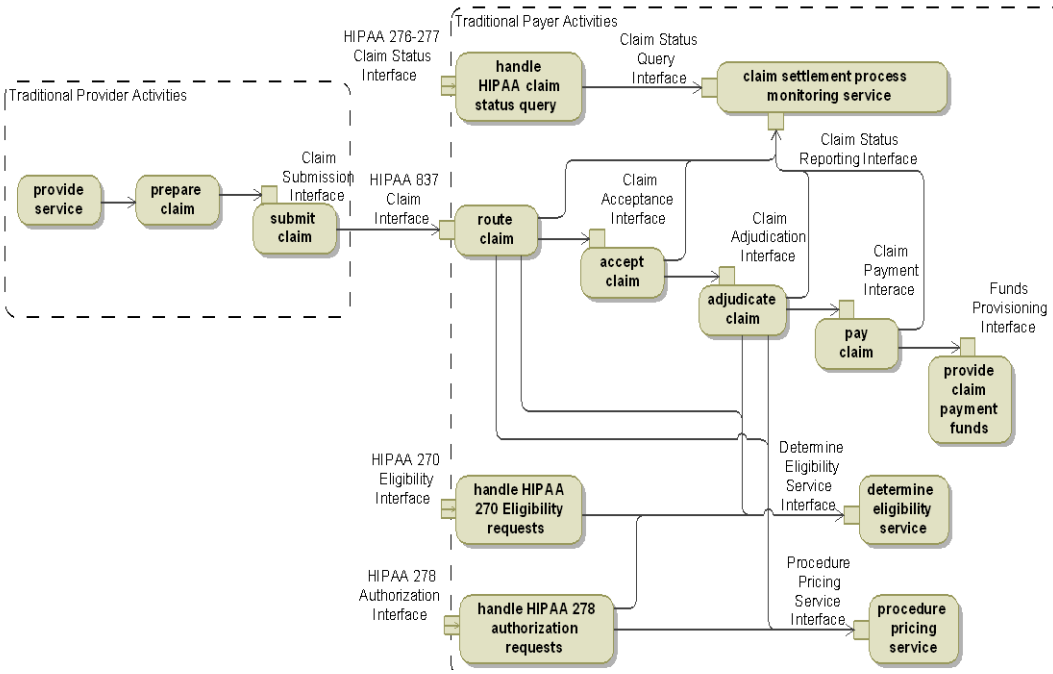


Figure 2: Business Process Reference Model Fragment

When different roles are played by different business parties the same functionality may be required by more than one party. This requires either that the parties replicate the function (along with its reference data and business rules) or that one of the parties provide an interface for the other to access the function. In the absence of standardized interfaces, neither option is attractive since both require extra work.

Determining eligibility provides a good example. It requires a significant amount of information about the health care policy, its rules regarding benefits, and the status of the member with respect to that policy. When a health benefits company outsources the acceptance and adjudication of claims, it is faced with the challenge of communicating this complex information in a form that can be effectively used by the other party. The other party is challenged to implement the business rules accurately.

The complexity of communicating this information and business rules is not to be underestimated. There are no standards for representing policies, benefits, and limitations, let alone standards for interpreting this information to answer eligibility questions (Figure 3). The parties involved in the business processes requiring eligibility checks are further constrained by the ability of their existing systems to represent and work with complex eligibility information and rules.

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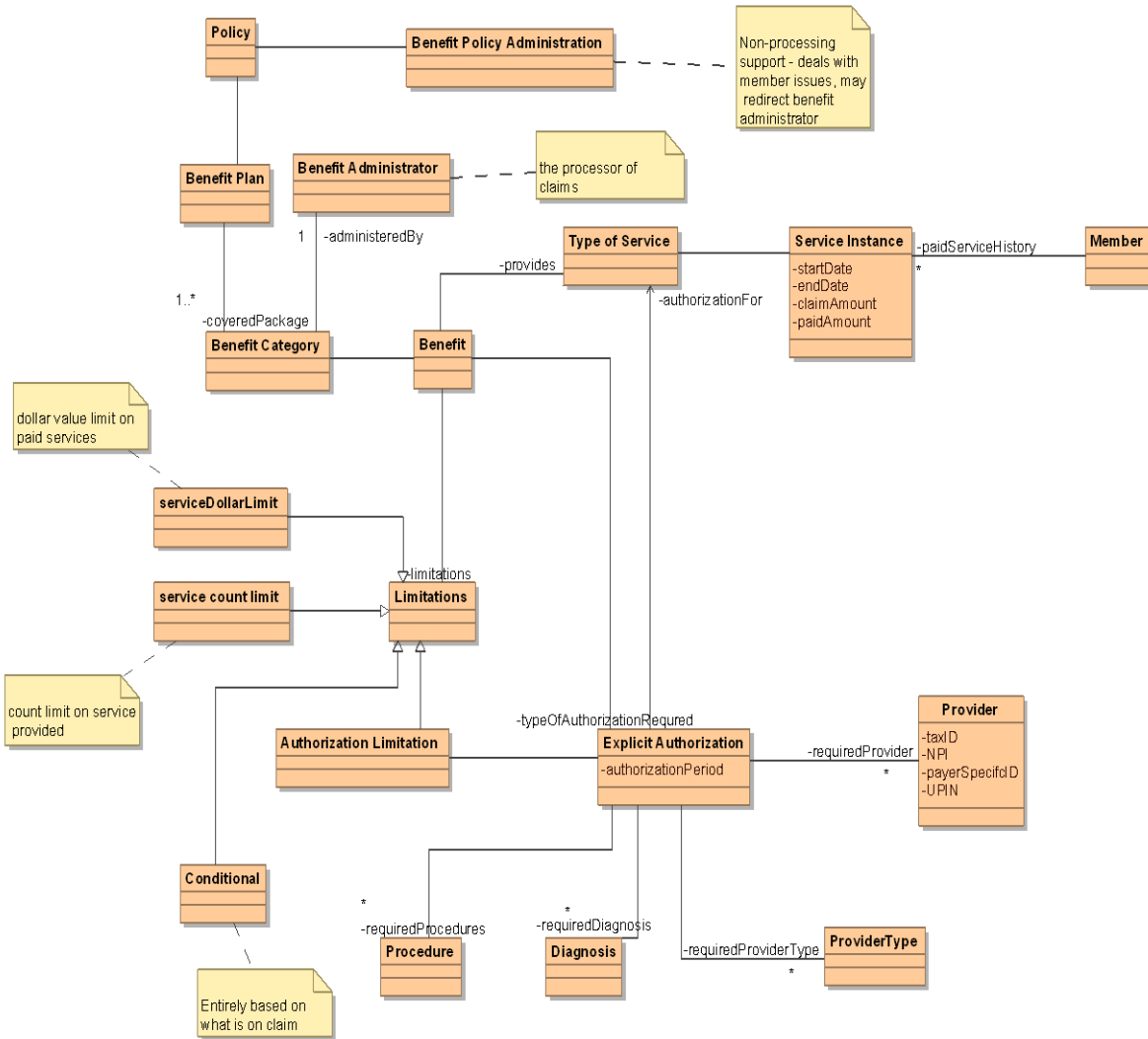


Figure 3: Sketch of Information Typically Required for Eligibility Checks

Ideally, eligibility checks are performed in the initial claim routing before the claim is even sent for adjudication. This is particularly beneficial when there are different downstream channels for different categories of benefits. The centralized eligibility check relieves the claims adjudicator of this responsibility and simplifies the resulting interactions between the parties. Similar arguments apply to the pricing of services.

Standing in the way of this ideal is an unfortunate reality: different downstream channels for different categories of benefits often impose their own business rules and define their own datasets and logic to support these rules. These constraints are often driven by the systems being used by these parties. The consequence is often different (and apparently arbitrary) rules governing different categories of benefits.

These differing downstream constraints make it difficult to implement upstream eligibility checks. The result is a limited upstream capability, often as simple as just determining whether the member was

covered by the policy at the time of service. The final eligibility determination is not made until the claim is adjudicated. Discovering an eligibility problem at this late stage delays the processing of the claim and requires a more complicated feedback path. It is hardly an optimal solution for any of the parties involved.

4.4 Monolithic Health-Care Applications Span Multiple Roles

Another burden on the health care industry is created by some of the commercially available health-care applications. These applications often make inappropriate assumptions about which roles are being supported by the software. These commercial off-the-shelf (COTS) products often assume that the entire claims settlement process - claim routing, acceptance, and adjudication – is being managed and executed by one party and one piece of software.^{9 10 11 12 13 14 15} This makes it difficult for a company that wishes to outsource aspects of its operations. These systems are incapable of managing just a portion of the business process. Available interfaces, if any, are proprietary and require custom development on the part of the business partner. In many cases, the ideally desired business process interface is internal within the software and is not accessible at all. For example, while many COTS health-care products both determine eligibility and price services, few provide the interfaces needed to invoke these functions independently of the actual claim processing.

5 The Health Care Reference Model Concept

Despite the ongoing experimentation with business structures, the business processes and roles being played in the health care business processes continue to remain relatively stable. This role stability can be leveraged to modularize the business processes by standardizing the roles and the interfaces between them.

5.1 Standardizing Roles and Interfaces

The claims settlement business process provides good examples of the role and interface standardization we are referring to (Figure 1). On the provider side, every provider must submit claims. This is an activity which, in the end, is ultimately a business-to-business interaction between the provider and the insurer. This process requires the preparation and submission of the claim, but there are many options for playing these roles. They may be performed by the provider directly, by one or more contracted parties, or by the provider and contracted parties. On the insurer side, the routing, claim acceptance, claim adjudication, claim payment, and funds provisioning may also be performed by various combinations of parties.

Standardizing the roles and the responsibilities that go along with them affords an opportunity to standardize interfaces between them. The challenge in standardizing these interfaces lies not so much in defining the operations that need to be provided but rather in standardizing the data that needs to be exchanged. Some of this standardization is already underway. ICD9, ICD10^{16 17} and CPT¹⁸ standardize the identification of diagnoses and procedures. The electronic health record¹⁹ and NHIN²⁰ initiatives seek to

standardize the representations of health records and other health-care information. Some of the best and most recent HIT standards work comes from the Office of the National Coordinator for HIT.²¹ The Council for Affordable Quality Care (CAQC) is developing standards involving payers.²² The Workgroup for Electronic Data Interchange (WEDI)²³ and the Centers for Medicaid and Medicare Services (CMS)⁴ are working on Electronic Data Interchange (EDI) standards.

A significant barrier to the adoption of standards is the continuing evolution in the field. The key to promoting adoption lies in making standard data structures extensible in a carefully controlled manner. Standardization and extensibility are not necessarily incompatible. The key is to recognize that the information, viewed abstractly, has an inherently stable structure – one that can accommodate extension without breaking current representations.

For example, consider the concepts related to a health care claim as specified in a HIPAA 837 claim submission (Figure 4). HIPAA requires information about *Providers* to be included, but constrains the specific roles that providers can play. The same is true for other entities such as the *Submitter* and *Payer*. The HIPAA model makes no provisions for representing other roles in the claims submission process.

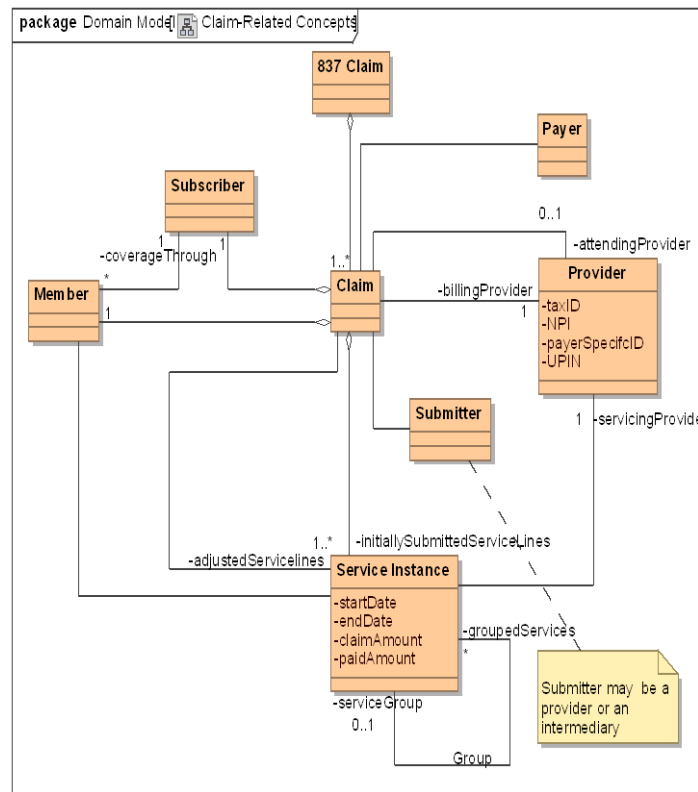


Figure 4: Claim-Related Concepts As Represented in a HIPAA 837

Now consider the more general model of this same information shown in Figure 5. This model still allows the HIPAA-specific roles for providers and other parties to be specified, but it allows additional

roles to be specified as well. In this example, the role of `claim preparer` has been added as an administrative role type. To support variability in the downstream processing of the claim, the administrative roles of `claim router`, `claim acceptor`, and `claim adjudicator` could be added as well.

Abstracting roles and role types is one way in which extensibility can be provided. Another is to make the set of attributes for a given concept open-ended. The core data structure specifies the standard fields, but allows other fields to be added. Support for this type of extensibility is inherent in the SOAP and supporting XML standards. It can be achieved through the appropriate use of XML “any” constructs, and the use of these extensions can be constrained in a well-defined and verifiable way through the use of XML namespaces. The XML 1.1 standard²⁴ adds considerable flexibility in this regard.

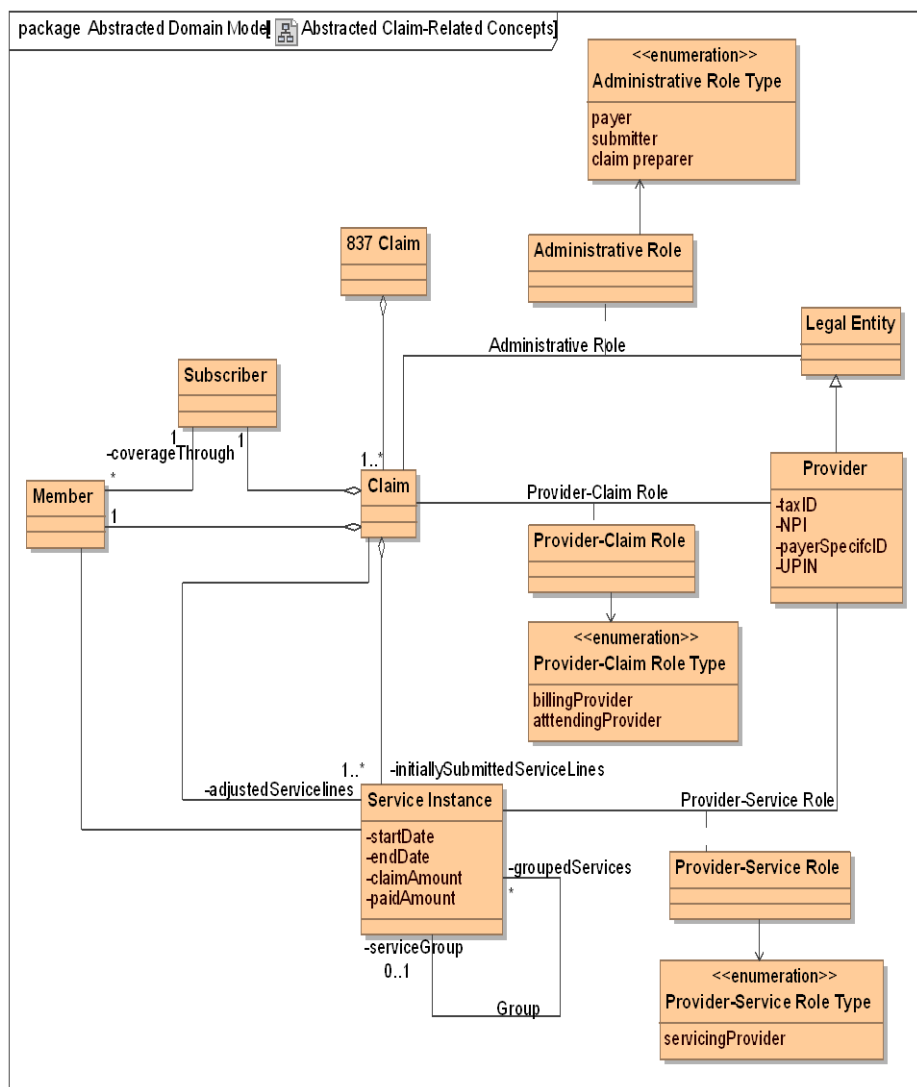


Figure 5: Abstracted Model of Claim-Related Concepts

5.2 Abstracting Common Functionality as Business Services

There are a number of functions that appear at multiple places in health care business processes. We earlier cited two: determining eligibility and pricing services. If these functions are provided as business services, then further flexibility in implementing these business processes can be achieved by standardizing and using these services. With this approach, any of the process participants can provide these services without modifying the business process.

5.3 Process Status Monitoring

One of the biggest challenges in today's health care business processes lies in determining status when the work is distributed among multiple parties. This distribution introduces complexity in determining status of the process and detecting process breakdowns. Status information is fragmented among the different parties, and routing obscures which party has the current status information.

Tracking transactions across multiple parties is very difficult in today's business processes. Parties typically do not provide visibility into their internal processes, and no single party knows the status of an in-progress transaction. Questions about transaction status require a two-stage investigation, first determining which party currently has responsibility for the transaction, and second determining that party's actual transaction status.

A solution to this problem is to introduce a new role for each major process, that of a *process monitor*. Figure 2 shows a monitoring service for the claims settlement process. The service provides two interfaces. The `Claim Status Reporting Interface` provides a means by which participants can report responsibility assignments and status changes. The `Claim Status Query Interface` provides a means for interested parties to obtain the status of a claim. The status that is tracked and reported by this service is a milestone-level status that is abstracted from the processing details, thus allowing the status itself to be standardized.

6 Reference Model Concept Benefits

The intent of the health care reference model is to standardize the partitioning of health care processing into standardized roles without constraining how those roles are actually implemented. Figure 6 shows an example in which two parties are cooperatively providing a health care plan. The "Nameplate" company provides full-service coverage for all benefits except vision care, which is handled by a separate company. All claim submissions are presented to the "Nameplate" company, which routes vision claims to the Vision company and retains the rest for internal processing.

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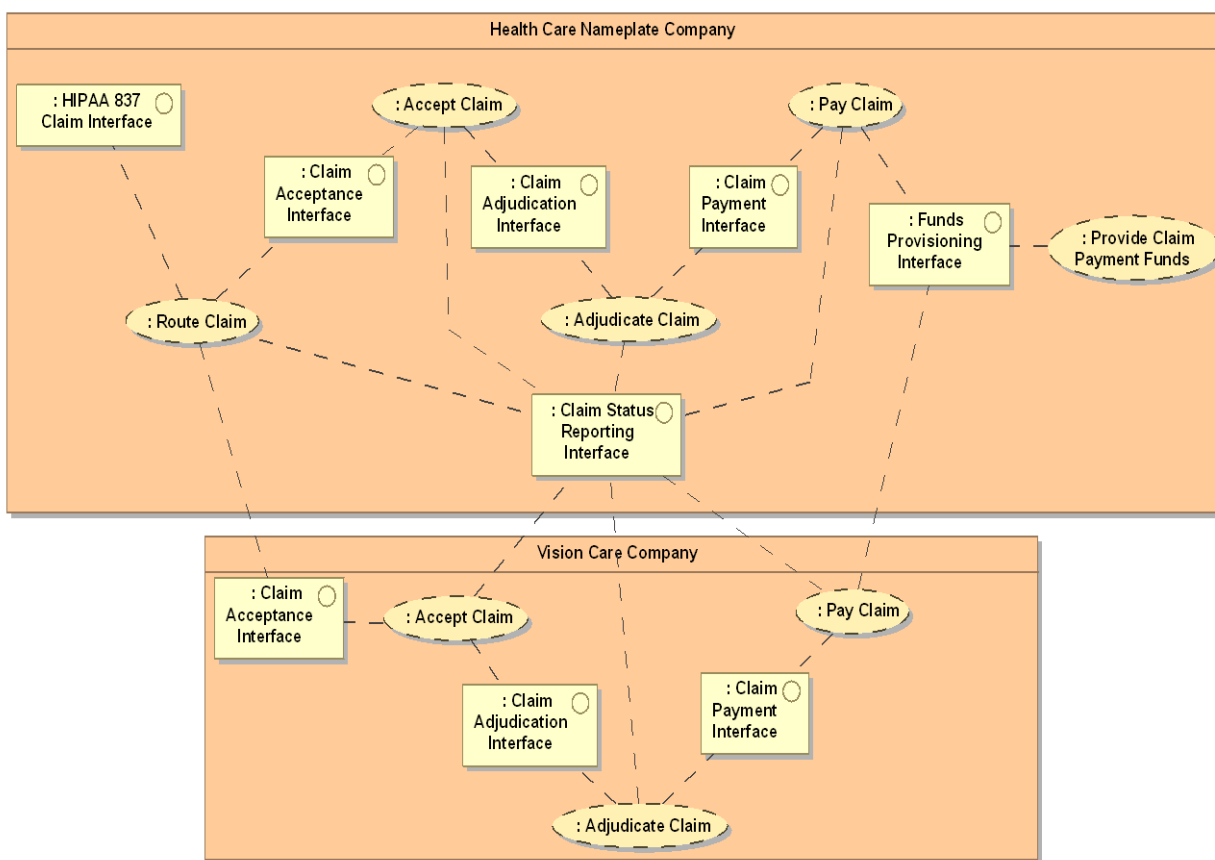


Figure 6: Example of Two Cooperating Parties

The reference model standardizes the business process roles and the interactions between them without constraining which parties play which roles. Most importantly, subsequent changes in role assignments (either through outsourcing or bringing roles back in-house) will not require the development of new interfaces.

Standardized interfaces will significantly reduce development and administrative costs. It will no longer be necessary to develop custom interfaces for each partner relationship. The use of SOAP and XML technology will enable more errors to be caught on the originating side of each interface, thus reducing the number of partner interactions required to resolve problems. And the centralized process monitoring service simplifies obtaining the process status and detecting breakdowns in the process.

Standardized roles and interfaces also present significant opportunities for software vendors and service providers. Vendors can build applications to these interfaces with assurance that they will interoperate with other elements of the health care process. Service providers can implement specific roles with confidence that their services can be readily incorporated.

¹ Health Insurance Portability and Accountability Act of 1996 (P.L. 104-191 - known as HIPAA), www.cms.hhs.gov/hipaageninfo/downloads/hipaalaw.pdf

- ² NEHEN Companion Guide: 837 Health Care Claim: Institutional, http://www.nehen.org/resources/NEHEN_837_Inst_RELEASE_07_Q1.pdf
- ³ NEHEN Companion Guide: 837 Health Care Claim: Professional, http://www.nehen.org/resources/NEHEN_837_Prof_RELEASE_07_Q1.pdf
- ⁴ Transaction Code Sets Standards, Centers for Medicaid and Medicare Services, US Department of Health and Human Services, <http://www.cms.hhs.gov/TransactionCodeSetsStandards>
- ⁵ Len Bass, Paul Clements, and Rick Kazman, Software Architecture in Practice, Second Edition, Addison-Wesley Professional, Boston MA, (2003)
- ⁶ Paul Harmon, *Business Process Change: A Manager's Guide to Improving, Redesigning, and Automating Processes*, Morgan Kaufmann, San Francisco (2003)
- ⁷ Jeanne W. Ross, Peter Weill, David C. Robertson, *Enterprise Architecture as Strategy*, Harvard Business School Press (2006)
- ⁸ Paul C. Brown, *Implementing SOA: Total Architecture in Practice*, Addison-Wesley Professional, Boston (2008)
- ⁹ DST Health Solutions <http://www.dsthealthsolutions.com>
- ¹⁰ TriZetto Healthcare Solutions: Health Plans <http://www.trizetto.com/hpSolutions/coreAdministration.asp>
- ¹¹ HP Technologies <http://www.hptechnologies.com/metavance.html>
- ¹² Ingenix Claim Adjudication & Reimbursement Management <http://www.ingenix.com/Products/Payers/ClaimsAdjudicationReimbMgmt>
- ¹³ ikaSystems ikaEnterprise <http://www.ikasystems.com>
- ¹⁴ PLEXIS Healthcare Systems: Plexis Benefit Administration Software http://plexisweb.com/solutions/software.html?gclid=CPCCho_f0058CFYZx5Qod5
- ¹⁵ Perot Systems (Xcelys® Payer Administration Software and Diamond® applications) <http://www.perotsystems.com/Industries/Healthcare/Payers/default>
- ¹⁶ ICD-9/10- Washington Publishing Company/ <http://www.wpc-edi.com/>
- ¹⁷ ICD-9/10- World Health Organization/ <http://www.who.int/classifications/icd/en/International>
- ¹⁸ Current Procedural Terminology (CPT) Online, American Medical Association, https://catalog.ama-assn.org/Catalog/cpt/cpt_home.jsp
- ¹⁹ Electronic Health Record (EHR), http://en.wikipedia.org/wiki/Electronic_health_record
- ²⁰ Nationwide Health Information Network (NHIN) <http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&cached=true&objID=1142>
- ²¹ Office of the National Coordinator for HIT, HIT Policy and Standards Committees http://healthit.hhs.gov/portal/server.pt?open=512&objID=1153&parentname=CommunityPage&parentid=1&mode=2&in_hi_userid=10741&cached=true
- ²² CAQH CORE. <http://www.caqh.org/benefits.php>
- ²³ WEDI/SNIP whitepapers/ <http://www.wedi.org/snip/public/articles/index~3.shtml>
- ²⁴ Extensible Markup Language (XML) 1.1 (Second Edition), W3C, <http://www.w3.org/TR/xml11/> (2006)