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Structural and Semantic Mapping of Application Programming Interfaces

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Abstract. Modern healthcare providers rely upon Electronic Healthcare Records (EHR) systems to record patient data inside their own organization. Some healthcare providers share this data to facilitate patient care with other providers. Medical devices and healthcare providers can use differing standards of recording healthcare information. The *Structural and Semantic Mapper Proxy API* solution offers a practical way to tackles the issues of Structural and Semantic mapping of Application Programing Interfaces (API) in a healthcare context to enable connection of all existing systems to a healthcare providers EHR creating a single source of truth regarding the treatment of patients and enabling healthcare providers to bridge the gap between external EHR systems.

Keywords. structural mapping, semantic mapping, interpolation, healthcare connectivity, proxy API

1. Introduction

The need for Structural and Semantic Mapping of API in a healthcare context arises from two distinct yet related needs for modern healthcare systems; to be interconnected within a healthcare provider so that they provide a seamless experience for healthcare professionals and patients during a patient journey where a central EHR System can provide a sole point of truth (Figure 1), and in order to enable the seamless integration of healthcare paths for patients between different healthcare providers reliant upon a variety of health systems with different underlying schemas (Figure 2).

The NHS moved to adopt a Fast Healthcare Interoperability Resources (FHIR)[1] standards[2] in 2019 to improve compatibility amongst their systems. A Structural and Semantic Mapping solution may prove useful for adapting legacy systems to FHIR conformance and enabling the use of modern non-FHIR compliant systems within the NHSs FHIR eco system.

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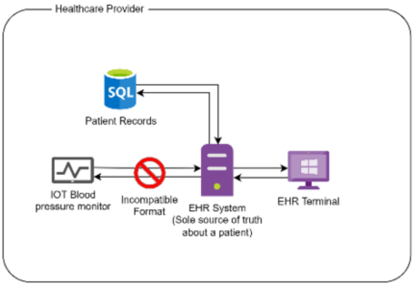
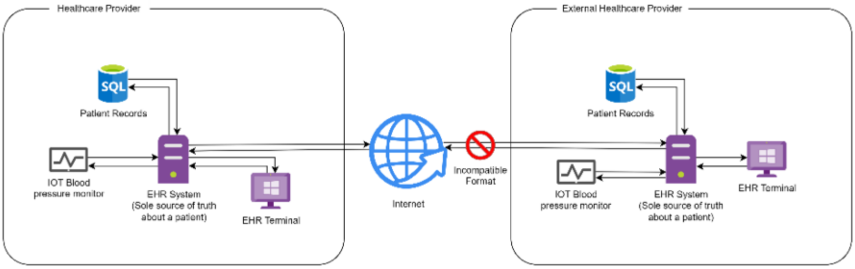

Healthcare Provider
SQL
Patient Records
IOT Blood pressure monitor
Incompatible Format
EHR System (Sole source of truth about a patient)
EHR Terminal

Figure 1. Healthcare Provider with Central Electronic Health Records System


Healthcare Provider
SQL
Patient Records
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EHR System (Sole source of truth about a patient)
EHR Terminal
Internet
Incompatible Format
External Healthcare Provider
SQL
Patient Records
IOT Blood pressure monitor
EHR System (Sole source of truth about a patient)
EHR Terminal

Figure 2. Healthcare Provider sharing patient data with an external Healthcare Provider

2. What is Structural and Semantic Interoperability

In structural mapping, the structural data is the data presented in a pre-defined schema such as Extensible Markup Language (XML) conformant to an international standards such as FHIR[1]. Structural interoperability is intercepting the structured data transmitted by one API, transforming the data into another structure and forwarding this data to a receiving API in an expected format.

In semantic mapping, the semantic data is any coded definition such as International Classification of Diseases 10 (ICD10) code “R51” for a Headache[3] that can be converted to SNOMED CT code “25064002”[4] . Semantic mapping is transforming the coded messages from one piece of data into the expected receiving format.

Structural and semantic interoperability is the marrying of these structural mapping and semantic mapping approaches to completely map data transmitted by the *Sending API* to the *Receiving API* through interception and transformation of messages so that two API communicate seamlessly with one another through our *Proxy API*.

3. Mapping configuration

The Java Script Object Notation (JSON)[5] formatted Open API mapping configuration file [Figure 3] follows the Open API 3.1 specification[6] and defines all incoming and outgoing routes for the mapper. The “path” route defines an endpoint to listen for the incoming request from the *Sending API*. The corresponding “callback” route defines where the *Proxy API* will transmit the interpolated request. The *Proxy API* will map parameters named on the “parameters” object between the path and callback routes where parameter names match. The *Proxy API* can use the “$headers” property on the mapping template to apply additional logic to transform items the parameters during the mapping process.

4. The Mapping Process

The *Sending API* can send a Get, Put, Post or Delete message to the *Structural and Semantic Mapping API proxy*. When the *Sending API* sends a Post or Put message to the *Proxy API* the *Proxy API* maps the incoming data structure from the source schema to the target schema using the corresponding callback for that method. For all methods The *Proxy API* maps parameters passed on the incoming route to the corresponding parameters on the callback route. The *Proxy API* calls the *Receiving API* using the callback route listed in the Open API schema[6] under the corresponding method sending a transformed body where applicable.

When the *Receiving API responds* to the request from the *Proxy API* the *Proxy API* maps the parameters from the callback route back to the method route. When the *Receiving API* returns a body with the response the *Proxy API* maps the response back to the source format. The *Proxy API* returns the mapped response message back to the *Sending API* thus completing an interpolated call.

5. Application

A healthcare provider can employ the mapper solution to bridge compatibility of internal systems (Figure 3) or several healthcare providers may connect their operations together by deploying mapper at each site operating on different healthcare standards (Figure 4). Healthcare providers can mix the deployment of the Mapper solution where *a Proxy API* standardizes each incompatible internal system for their EHR then connects to another healthcare provider with an incompatible EHR using a *Proxy API* between each of the EHR systems.

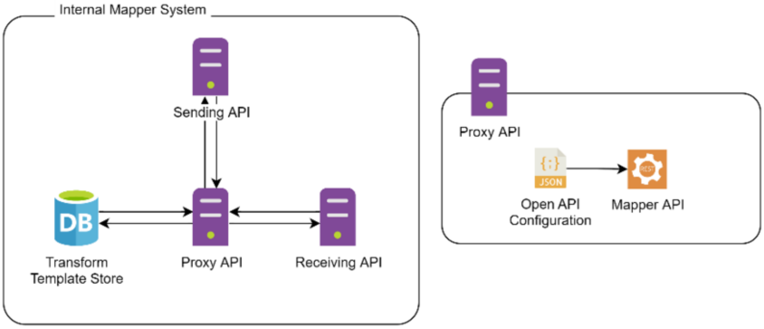

Figure 3. Internally Mapped System

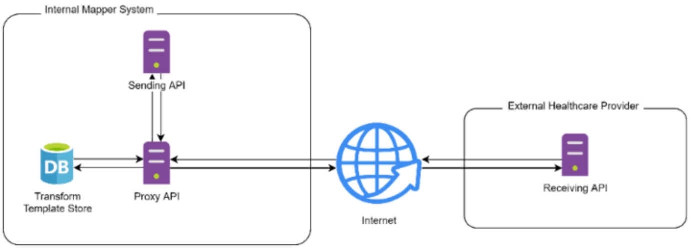

Figure 4. Externally mapped system

6. Concluding Remarks

The presented Structural and Semantic Mapper solution is both a simple and effective way to bridge the gap between incompatible EHR systems. The system allows Healthcare providers to join existing legacy equipment and new equipment to their EHR creating a more consistent patient experience by enabling healthcare providers to hold a single source of truth about patients in their EHR system as opposed to using multiple disconnected systems. The mapper solution helps healthcare providers connect to each other enabling the sharing of patient information between different healthcare providers and such as general practitioners and hospitals operating with different systems to share data between their EHRs without changing their internal systems.

There is future potential for developers to embed the Structural and Semantic Mapper solution inside commercial applications enabling developers to target a single healthcare format such as Human API while the integrated mapper makes their API compatible with a range of global standards like FHIR out of the box.

Acknowledgements.

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