

Application of HL7 FHIR in a Microservice Architecture for Patient Navigation on Registration and Appointments

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Overview

- 1 Introduction
- 2 Methods
- 3 Results
- 4 Discussion
- 5 Final Considerations



Introduction

- Interoperable Electronic Health Record Systems(EHR-S):
 - Communication through a common interface [12]
 - Incorporate standards such as openEHR [6], ISO 13606 [8], HL7 [7], among others
- **Problem:** Most of the EHR-S are developed as monoliths [2, 14, 4]
 - Difficulties on exchanging data between actors
- **Need: strengthening the continuity of care mechanisms [9]**

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Introduction

- **Example:** Patient Navigation (PN) [15]
 - Allows health professionals to provide guidance to patients on the continuous provision of care
 - Requirements → interoperability with existing EHR-S
- Patient Navigation (PN) → 3 main steps:

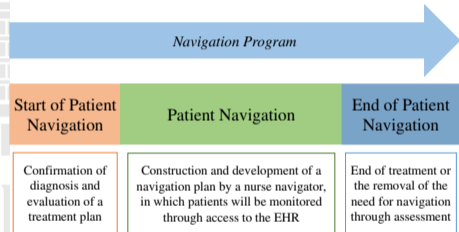


Figure: Simplified visualization of process for Patient Navigation (PN)

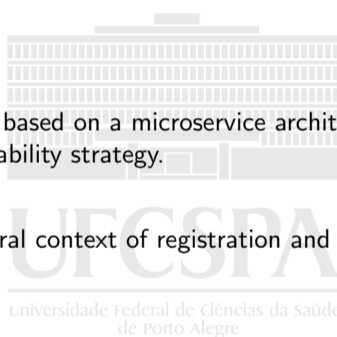
Introduction

- In other words...
 - Existing EHR-S could be reused and supplemented with new PN data when necessary
- Modifying current systems to include new processes, such as PN, could take time and/or resources
 - New and current EHR-S must incorporate a versatile and connectable strategy to enable interoperability with current or legacy system
- **Viable solution:** Use HL7 *Fast Healthcare Interoperability Resources* (FHIR)

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Introduction

- **Aim:**
 - Develop a prototype, based on a microservice architecture that incorporates HL7 FHIR as an interoperability strategy.
- **Case approach:**
 - Simulate the procedural context of registration and scheduling of patients in PN



Methods

- HL7 FHIR (in isolation) **may help** solve some health data communication **interoperability issues**

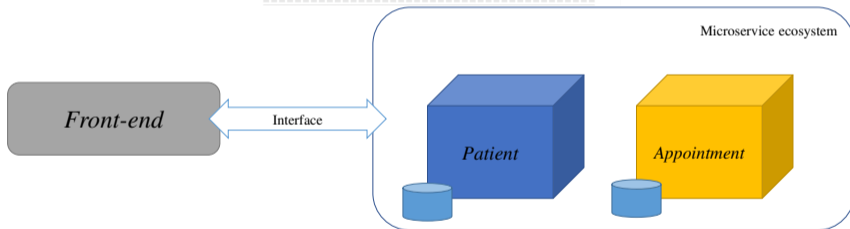


Figure: Architecture model

Development

To respect the single responsibility model, we use a Chassi Pattern, composed of **five subunits**

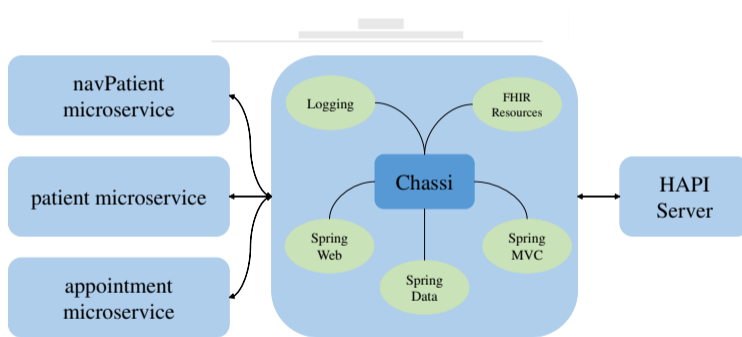


Figure: Chassi Pattern. The central box is the chassis, which consists of these subunits in green

Development

Integration with auxiliary systems happened in 2 ways:

- Through REST connections to query data already recorded in the system; and
- Access to a **NoSQL database** [5]

To focus directly on the business rules to be developed, we decided to use the Spring Framework.

- The **REST layer** was developed with **REST layer**
- The connection via JDBC using **Spring Data** was performed with **MongoDB**

Communication and HL7 FHIR compliance and Front-end

The REST communication exposes microservices functionalities through HTTP operations, allowing the exchange of information over the network. For this project, the establishment of communication and data exchange is made using:

- HL7 FHIR Version R4
- HAPI *Sandbox*

A *backend* serving the *frontend* (*backend for frontend* or BFF) [10, 1] is responsible for interacting with the user and facilitating data exchange. We developed an interface using Bootstrap.

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HL7 FHIR

For the development of current strategy, the following HL7 FHIR resources were identified:

- *Patient*
- *Appointment*
- *Participant*, between *Patient* and *Appointment*

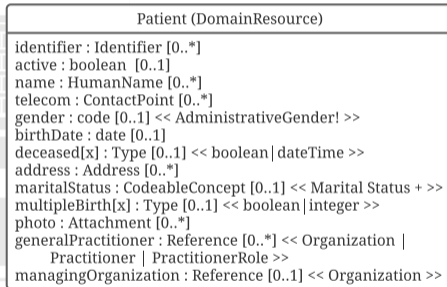


Figure: UML description of the resource *Patient*

HL7 FHIR

- To enable operations such as REQUEST and RESPONSE, it was necessary to include *Bundle*

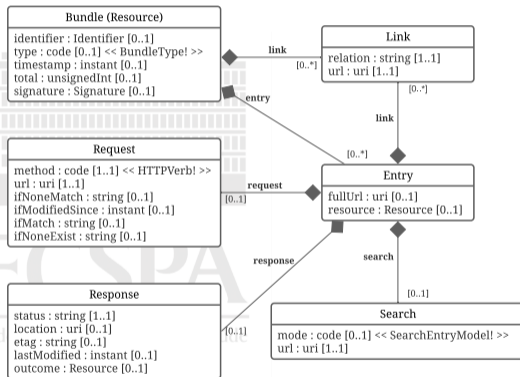


Figure: Specification of *Bundle*

HL7 FHIR and Microservices

- We subdivided the microservice into **four core components**:

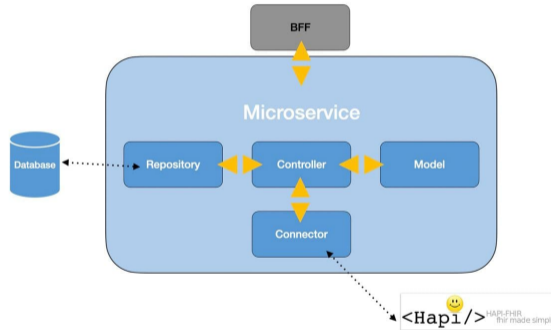


Figure: Interpretation by internal of the microservice strategy.

Prototype: Schedules and consultations for Patients Navigation

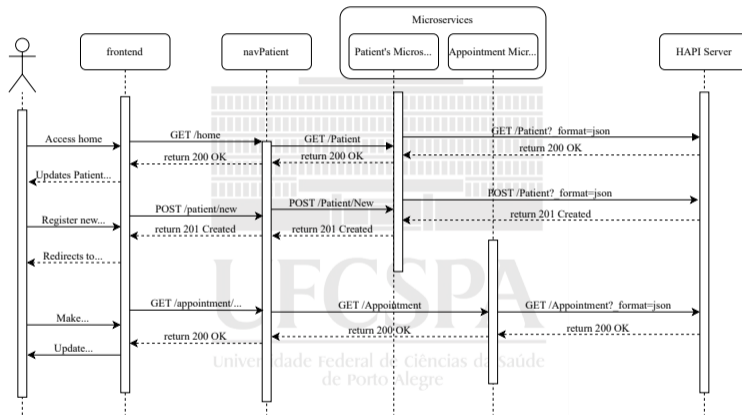


Figure: Sequence diagram showing the Communication Process

Discussion

- In this study, we applied current practices from literature, of the process of modernization legacy systems
- We chose to implement synchronous microservices to demonstrate its feasibility for deploying HL7 FHIR based applications
- Concerns with the ability to evolve projects [3]:
 - ① The deterioration of the internal structure of systems
 - ② The high number of entry points for client applications
- In this type of scenario, the **microservice architecture is well-suited** [18]

Discussion

Disadvantage with the increasing popularity of microservices

- Use in cases where costs overcome benefits
- Monolithic projects will continue having internal modularization, but not so isolated as with the use of microservices

- Our work sets out in detail all stages of building microservices with HL7 FHIR
- We find other initiatives that are also attentive to the future of EHR-S architectures [17, 16], and also propose the use of interoperability standards and microservices

Discussion

Some **difficulties were encountered** with the incorporation of HL7 FHIR and microservices:

- Understanding of what a microservice is, how big and how it differs from a service
- Scarcity of practical materials on the subject, as it is still a new topic for the academy [13]
- Our study faces limitations regarding the evaluation strategy employed

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Final considerations

- Solution
 - Registration and scheduling patients with microservices and HL7 FHIR
 - Simulating the context of PN
- When compared to the literature, this work fits into a restricted set of few available approaches.
- Allows expanding the possibility of conducting new research in which not only the traditional concepts are used (such as REST), but other asynchronous approaches.
- **Under development:** event-driven microservices and HL7 FHIR [11].

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