***Student Degree Record Exchange Standard***

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*Abstract*— Student degree record is currently exchanged manually between educational institutes in Pakistan. In this paper, we put an effort to suggest a prototype data format and architecture for enabling these institutes to inter-exchange student degree record digitally. To ease implementation, we suggest a mapping tool to semi-automatically create mappings between our standard and the university datasets.

Keywords— data exchange format; bologna process; XML to database mapping

# Introduction

Degree records are not exchanged digitally in Pakistan at this point in time. This causes delays in the process of verification of degrees. However, there is a central accreditation authority called Higher Education Commission (HEC) which is responsible for accreditation of universities and it also attests the degree documents but verification is only performed by the degree issuing authority, the university.

This paper digs into the currently adopted solutions, standards and the new research and suggests a prototype infrastructure including data format and the architecture to exchange degree records digitally. For making it successful, our proposed infrastructure should be less error prone and easy to implement. To achieve this goal, we suggest a mapping tool which semi-automatically maps universities’ datasets to our proposed standard and creates web-services to access their data.

# Background and Literature Survey

There exists some work which has already been done for exchanging degree records. Let us look into these first.

## Bologna Process

It aims to develop European educational framework of standards enabling different countries to compare and make compatible their educational systems [[1](#Bologona)]. There exists many related data exchange standards and related systems;

## Data Exchange Standards

These are;

### European Qualifications Framework:

EQF is a common reference framework that will help participating countries to compare national qualifications and make them more readable across Europe. The aim is to promote mobility of workers and learners. This was agreed upon by European universities in 2008 to relate their national qualifications to EQF [[2](#Pou11)]. The new qualifications from 2012 carry a reference to suitable EQF level.

EQF consists of eight reference levels representing what a learner knows and is able to understand. National qualifications of the participating countries relate to these eight levels ranging from basic level (level 1) to advanced level (level 2). This enables comparison of qualifications in different countries easy, thus providing support for mobility for learners and enabling them to not repeat what they have already learned.

EQF focuses on learning outcomes instead of focusing on learning inputs. It covers all types of education including vocational, professional, school education and qualifications. It tries to validate formal as well as informal education.

### Europass:

It is collection of five documents which intend to ease mobility in European job market. These include the Curriculum Vitae, the Language Passport, the Mobility, the Diploma Supplement, and the Certificate Supplement. One can fill himself the Curriculum Vitae, and the Language Passport but the rest of the documents are issued by the corresponding authorities. It follows a template format system. All documents having same format help to achieve neutrality and transparency while presenting one’s skills.

The motto as mentioned on the Europass website’s homepage is as follows;

“Five documents to make your skills and qualifications clearly and easily understood in Europe”

Europass has defined XML schemas for CV and Language Passport. The documents can be exported in XML format when created on Europass. These exported XML documents can be imported to Europass and converted to HTML, PDF, Microsoft Word or ODT templates.

Europass specifies JSON schema according to Internet Engineering Task Force’s JSON specifications draft. The europass JSON vocabulary is close and similar to europass XML schema. The JSON objects for europass documents (CV and Language Passport) can be validated using Europass JSON validator.

All these documents have some common XML schema attributes which describe document type, printed preferences.

Europass does not explain details related to degrees or educational certificates in XML certificate.

#### ECV: Europass Curriculum Vitae is a template which one can create online and it can be exported in xml format. The ECV XML schema contains vocabularies related to document type, printing preferences, personal details, contact details, skills, and educational degrees and institutes. The XML vocabulary related to degree details is very little only to cover the scope of a CV.

#### ELP: Europass Language Passport is a template. One can create it online and export it in europass xml format. It contains XML vocabulary related to language skills and the scale of six values to score proficiency.

### Schema for Academia:

Schema for Academia (SCHAC) describes vocabulary related degrees and courses. The schema is written for LDAP (Lightweight Directory Access Protocol). It aims at promoting a common framework to inter-exchange data between educational institutes. It defines attributes that describe individuals and their LDAP profile.

### Dublin Core:

The Dublin core is a simple meta-data standard consisting of set of elements to describe information resources on the network. There are two type of elements; simple and qualifiers. It has 15 simple elements and qualifiers which have additional three elements namely Audience, Provenance and RightsHolder. Qualifiers help in resource discovery.

## European Learner Mobility

Some related work has been done recently and systems have been proposed based on the above mentioned standards. These are “The Mobility Project” and “The REST Mobility” projects.

### The Mobility Project:

It aimed to provide a platform and infrastructure for exchange of electronic data exchange between educational institutes. Infrastructure includes data format, architecture and the prototype software. The system will be called The Mobility [[3](#TheMobilityProject)] later in this paper.

The Mobility is peer to peer like architecture. Nodes exchange data using SOAP base web service. Other web services like XML-RPC and REST were not used due to their limitations. XML-RPC not have developer defined data-types and character set. REST does not imposes a standard specification, instead it follows set of rules and is used for speedy development of web service interface.

The nodes represented the universities, and their number tends to change. So there was a need for system to maintain this record and UDDI was used. He did not recommend the central or delegated private registry instead gave advantages and disadvantages of both. Central single registry has all information at one place but also it a single point of failure.

The software has two transport modules and each have web interface.

Nagrozki proposed a new standard, defined its vocabulary re-using ideas taken from SCHAC to leverage ISO and RFC rules. Some like grade, credits were taken in inspiration from Eropass Mobility.

Although The Mobility project was started by MUCI and CINECA, two European Higher Education Consortia. Many universities consortia, individual universities and companies joined in later on.

### The REST Mobility:

This is alternative implementation of The Mobility. Nagrozki’s system used SOAP web service for data exchange. Karol created a RESTful implementation of the Mobility. The Mobility lacked data model. In The REST Mobility [[4](#RESTMobility)] a data model is proposed since REST is resourceful. The model proposed not represents or intends to be a standard.

## Information Manyfold

Providing a uniform interface for querying data from many sources is the aim of Information Manifold [[5](#Halevy)]. It enables a simple user to not worry about locating sources and manually combining results. This leads to concept of Deep Web. Data integration systems give users a common global schema called mediated schema for posting queries. To answer these queries semantic relationships called mappings are needed between mediated schema and the sources schema.

## MAPQFTOOL

This tool helps comparing National Qualification Frameworks against European Qualifications Framework in Europe. This automates the process of creating mappings between these frameworks and stores the mappings in the database.

# Critical Analysis

Degrees are attested without any data, but by analyzing the certificates and signatures only. The standards we discussed in the literature review do not fulfill all the requirements of what we need in Pakistan. The Mobility Project fulfills many problems but not support some unique features like it do not supports the 2-year academic length degree documents. So, we need a new standard and architecture which fulfill our needs.

# Proposed Insfrastructure

We suggest a data exchange standard and a prototype infrastructure to address these problems. The data exchange standard is called Student Degree Record Exchange Standard (SDRES). It has following key features.

* It is SOAP based because it uses XML over HTTP which is well established and provides abstraction from network details.
* The Mobility Project’s standard fulfills some vocabulary requirements, we will reuse these terms.
* It will have vocabulary for annual based courses as well as vocabulary related to semester based system.
* It reuses the ideas from SCHAC as it uses ISO norms where possible. For example, using ISO country codes.

We suggest student exchange system will have distributed architecture. Each university has its own data and signs agreements with HEC for exchanging data with other universities. Each can be a requester plus a provider of data. The circles/nodes in the figure below represent universities

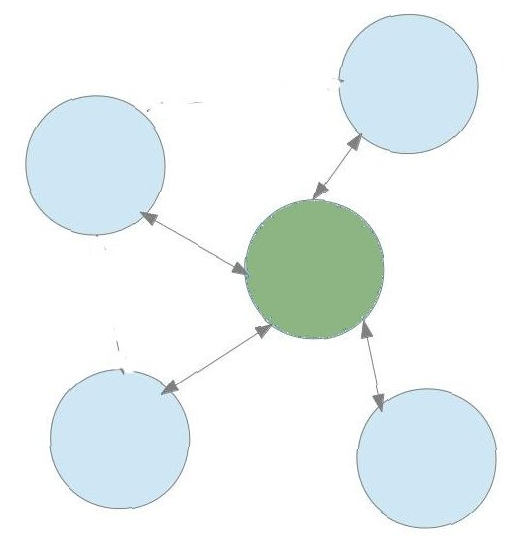


Fig 3: Nodes Interaction Diagram

In our proposed architecture, data is owned by the each provider node itself. So, it needs to create a SOAP based web-service in accordance with our proposed standard. This is very time consuming, error prone and effort driven task. To ease this process, we proposed a “MapperTool”. It creates mappings between university data-sets and XML tags and takes care of data marshaling. The mapper runs a wizard and stores mappings in the form of JSON on the disk. At the end;8 of the wizard, it returns a web-service URL. The web-service uses these mappings to access data in the university database.

# Validation

## Business Process

There are many universities. For two universities to exchange data, they have to create an agreement first. The agreement will have the list of documents for which data exchange is available and exchange secrets will be generated.

### Make Agreement:

For a university to be part of the system, it has to sign an agreement with the HEC. To do this, it has to implement a web service and provide URL to HEC. The HEC will be requester as it requests for the data and the provider is the university.

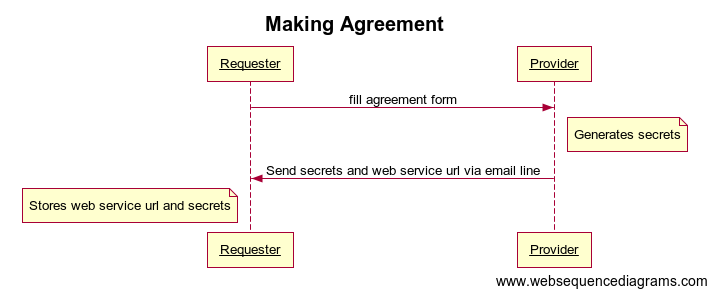


Fig 4: Making Agreement

### Finding Student Data:

To find a student record, the requester selects the university from the list of universities that has made an agreement. After selecting university it provides the search criteria and request will be sent to the corresponding university web-service.

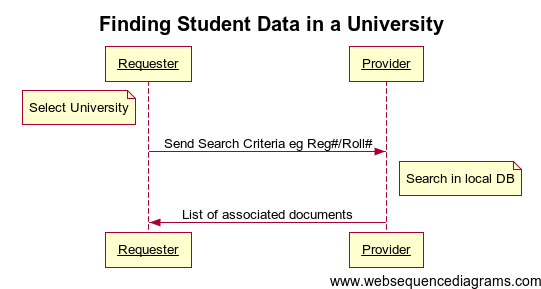


Fig 5: Finding Student Data

### Validating a Document:

To validate a student record, the requester selects the university from the list of universities that has made an agreement. Then it provides the search criteria, document type and request will be sent to the corresponding university web-service.

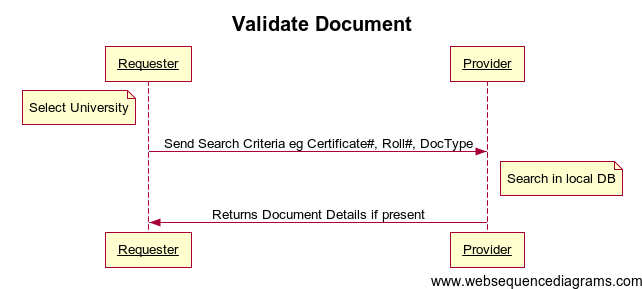


Fig 6: Validating Document

### Checking Registration:

To validate a student record, the requester selects the;2 university and it provides the search criteria for example NIC to search for the registration of student in that university.

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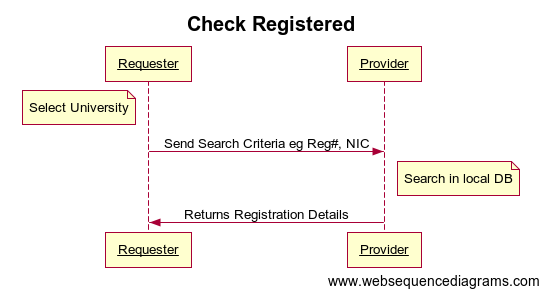


Fig 7: Checking Registration

## Architecture and Design

From use cases and the business requirements, we suggest student exchange system will have distributed architecture. Each university has its own data and signs agreements with a central authority, in our case HEC, for exchanging data with other universities. The central node will be a requester and the rest will be provider of data. The circles/nodes in the figure below represent universities and the green circle represents the requester that is HEC. The arrows represent exchange of data.

This peer to peer like distribute architecture has benefits over adding a middle agent or central server in the system.

1. Avoidance from single point of failure.
2. Lesser load.
3. Each university having control over its own data and thus building trust in the system.

However, the above architecture we proposed is a hybrid one. The reason to use this approach is to have benefits of both. Each university has its own data, but requester is only one. This introduces control and quality.

Now we need to decide how these nodes will exchange data. Which protocol will be used for data exchange. There are some choices to be made at this point. We will be using web services for exchanging data as they provide a high abstraction from network issues and use well known standards like XML over HTTP. There are some XML based data exchange protocols on web. These are XML-RPC, SOAP, and REST.

The nodes will exchange data using SOAP based web service in our system. We chose SOAP as it forces to follow a formal standard and supports developer defined data types.

The number of universities can increase when agreements are signed with new universities for exchange data. The web service URLs need to be saved so that requester can retrieve;2 this URL and request that university. This can be achieved by developing a custom system or using UDDI.

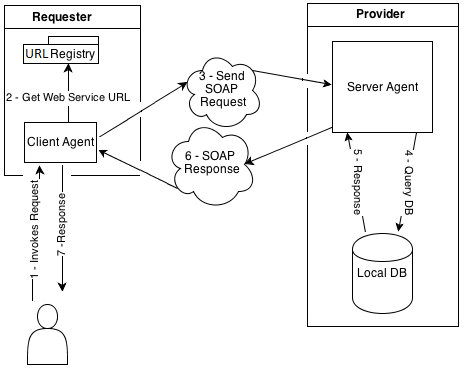


Fig 8: Architecture Diagram

## Implementation

First we setup a registry server to store the URLs of the web-services provided by different universities. This is done by making an agreement with each university.

Then take a sample university database having degree record. For sample database we will be using MySQL DBMS. Apply operations on the data-set and return corresponding response. This exchange of information is done in XML SOAP format as it forces to follow a specification. The SOAP server will be implemented in PHP.

Below is the list of operations available;

1. Make agreement: Storing web-service URL in the registry.
2. Find student data in university using SOAP service.
3. Validate a degree document.
4. Check registration of a student in a university.

When using SOAP format, it is optional to use WSDL. It is a web service description language document. We generated this document using php2wsdl tool. This is an open-source PHP library used for generating WSDL document.

# Conclusion

The proposed infrastructure enables degree issuing authorities to exchange data with other organizations while maintaining the ownership and control of their own data. This automatically builds trust in the system. It is anticipated that this infrastructure and the mapping tool will be useful assets for HEC, educational institutes and the people.

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