Sharing Telematics Courses - The CANDLE project

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Abstract: To ease the creation and use of web-based course material, some of the leading european universities and companies in the area of telematics started a project, named CANDLE (Cooperative And Network Distributed Learning Environment)[1]. This project has three different goals. First it plans to provide a service to coordinate the joint development of course material. To demonstrate the benefit of such a service, the second goal is to create web-based material for courses in the area of telematics. The third goal of the project is to develop a number of methods that guide authors in using the service and ease the transformation of traditional course material into reusable web-based material. This paper discusses these main goals of the CANDLE project.

Keywords: CANDLE project, Open courseware, courseware repository

1 Introduction

Only a few decades ago it was still common that teachers at universities used the blackboard to write down course notes. Students had to copy these notes from the blackboard, and some students even earned money by selling such notes. After text processors and photo-copiers entered the universities, many teachers started to create readers and distribute course material themselves. At that time teachers at different universities hardly collaborated, and readers produced at different universities looked quite different. The more active teachers improved their readers year after year, and some of these readers finally got published as a book. Often these books were not only used at the teacher's university, but also at universities elsewhere. Since a single book could be used by thousands of students at hundreds of universities, authors received quite some feedback and it became worthwhile for a small number of authors to keep improving the quality of their books. This process went on for many years and nowadays there are, for each typical course in the area of ICT, probably ten different books that are used by 80% of the teachers.

Although books have many advantages, they also have a couple of disadvantages. In particular they lack the animation, multi-media and interactive facilities that can make teaching more productive and fun. It is therefore not surprising to see that gradually teachers spend time on creating web material, such as colourful animations and interactive exercises. To some extent the development of such material can be compared to the development of books: only material used by thousands of students at hundreds of universities receive sufficient feedback to allow the continuous improvement of the material. A difference between web-sites and books, however, is the fact that web material need no longer be produced by a single or just a small number of authors; by using web technology it is now possible that many teachers collaborate

1. The CANDLE project [1] is supported by the European Commission (IST-5th Framework Program), code: IST–1999-11726. The partners within CANDLE are: Universität Karlsruhe (DE), British Telecommunications (UK), École Nationale Supérieure des Télécommunications de Bretagne (FR), Norwegian University of Science and Technology (NO), University of Twente (NL), Institut National des Télécommunications (FR), Institute of Education (UK), Politecnico Turino (IT), Suffolk College (UK), University College London (UK), Universitat Politècnica de Catalunya (SP) and Universität Stuttgart (DE).

and improve material together. Because of the openness of this process, the resulting web material is sometimes called ‘open courseware’.

To ease the creation of open courseware, some of the leading european universities and companies in the area of telematics started a project [2], named CANDLE (Cooperative And Network Distributed Learning Environment). This project has in fact three different goals. First it wants to provide an open courseware service, which can be regarded as a kind of infrastructure to coordinate the joint development of course material. To demonstrate the benefit of such a service, the second goal is to create a base set of open courseware components. The third goal of the project is to develop a number of well-defined methods that guide authors in using the service and that ease the transformation of existing course material into open courseware.

The structure of this paper is as follows. Section 2 presents the open courseware service and the ways it can be used. Section 3 gives a short overview of the various courses for which material will be developed, and gives some more detail for two of these. Section 4 discusses the methods that have been developed thus far to structure and annotate open courseware. Section 5 presents the conclusions.

2 The open courseware service

The basic idea behind the open courseware service, is to improve the quality of course material and to reduce the cost of developing telematics courses by sharing and re-using material via the Web. The courseware service can be used by authors, who create new material or modify existing material, as well as by teachers, who select and down-load course material from the courseware repository. To maximize flexibility and improve performance, the courseware service is not designed as an all-embracing system that delivers courses directly to students. Such facili-

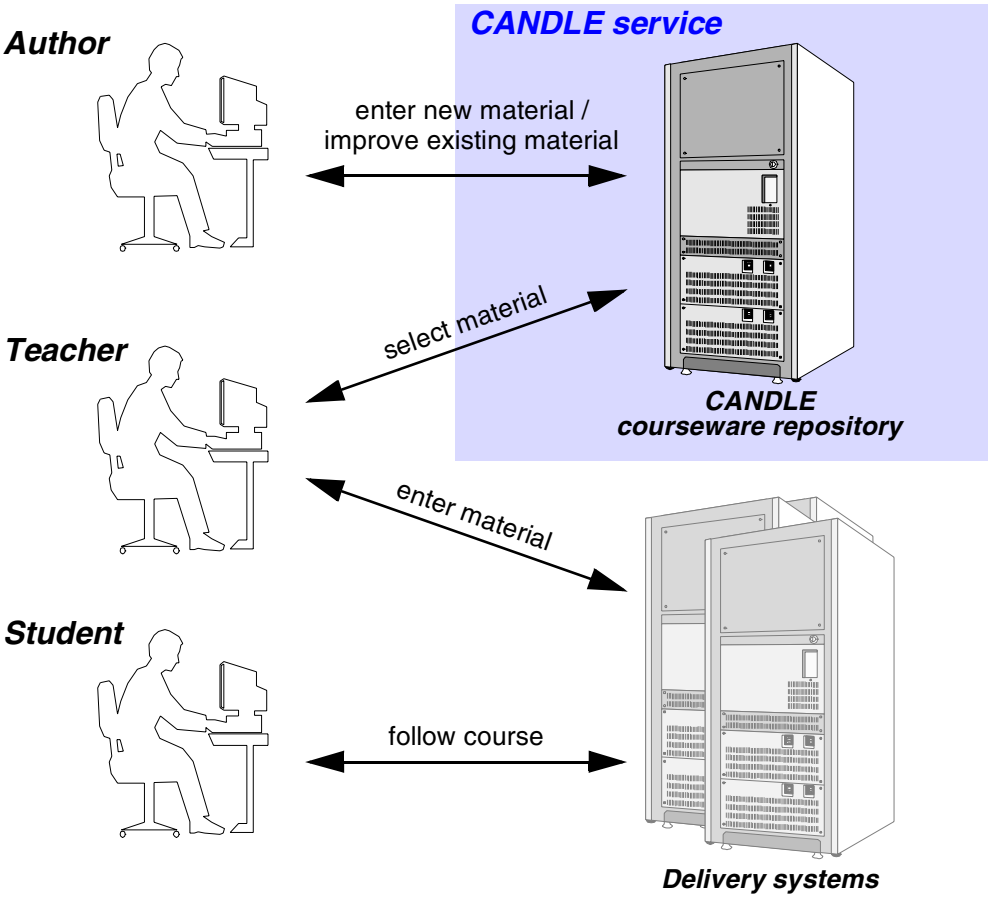

Figure 1: Open courseware service

ties can better be provided by dedicated delivery systems; it is the responsibility of the teacher to enter the course material that was obtained from the courseware service into such a delivery system. Figure 1 shows the basic use of the courseware service.

The material created by authors can range from a simple powerpoint slide, a set of slides, figures and pictures in (animated) GIF or JPEG format, web pages, applets, movies etc.. The granularity can be fine, such as in the case of simple figures, or coarse, such as in the case of complete courses. Fine granularity is particularly useful for introductory courses such as, for example, courses on 'the foundations of telematics'. Such courses are given at nearly every university and teachers often have slightly different ideas about which material should be presented, and which material shouldn't. With many small pieces of material (fine granularity), every teacher will have to possibility to create his / her own favourite flavour of the course. Coarse granularity is primarily useful for specialised and advanced courses, where only a small number of teachers have sufficient knowledge to create high quality material.
Besides creating new material, authors can also use the courseware repository to modify existing material and, for example, translate material into another language.

With every piece of course material authors should associated meta-data. Examples of possible meta-data fields are: the description of what the material is about, the name of the author, its contact information, the language being used, the location where the material can be found (this may be URL) and how it is formatted (expressed as MIME type). A detailed description of possible meta-data fields is given in Section 4.1. Meta-data is expressed using XML and put in separate files. As opposed to the actual course material, which may be stored on the courseware server or on a server elsewhere, meta-data files will always be stored on the courseware server. To ease the creation of meta-data, the courseware service includes a special editor, which can operate within a web browser and which offers traditional cut and paste commands.

The role of a teacher starts with selecting course material from the repository. To make a selection, the teacher uses the service's search facilities, which analyse all meta-data. After the selection is made, the teacher should off-load the repository system by retrieving the selected material from the repository system and put it on an existing delivery system. Such system may be an ordinary web-server, but also a specialised system such as, for example, the Teletop system that was developed by the University of Twente [3].

Figure 2 shows when the CANDLE service will become available for whom. At the initial stage the service will be available to the institutions that collaborate within the CANDLE project. At that early stage teachers can use arbitrary keywords to search through the meta-data within the repository. At later stages searching may become easier after ontologies have been introduced. Around summer 2002 the service will become available for all EUNICE members; one year later the service should be available for the rest of the world. It is important to note that the service may not only be interesting for universities, but also for enterprises, since teaching does stop after a person leaves the university.

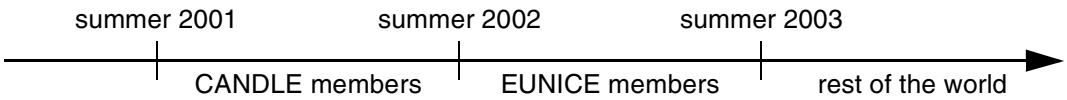

Figure 2: Availability of the service

3 Courses

The second goal of the CANDLE project is to create a base set of open courseware components that demonstrate the power and advantages of the CANDLE a service. Although in theory the CANDLE service should be useable for every kind of course, the partners within the CANDLE consortium have expertise in the area of telematics and will therefore concentrate on courses in that area. Examples of courses for which partners have expressed interest are:

- Foundations of Telematics
- Internet protocols
- Middleware
- Network Management
- Internet Management Protocols
- Network security
- Routing Algorithms
- Access Networks
- LANs
- Mobile Communications
- Mathematical methods for Telematics
- Formal methods for Telematics
- Coding Theory
- Information Theory

To give an impression of how material for these courses might look like, the next subsections discuss two examples.

3.1 Foundations of telematics

An example of a course that is given by most universities, although in different forms, is the course 'foundations of telematics'. This course is usually provided within the first years of the study, and may contain, next to an *introduction*, topics like *communication networks*, *distrib-*

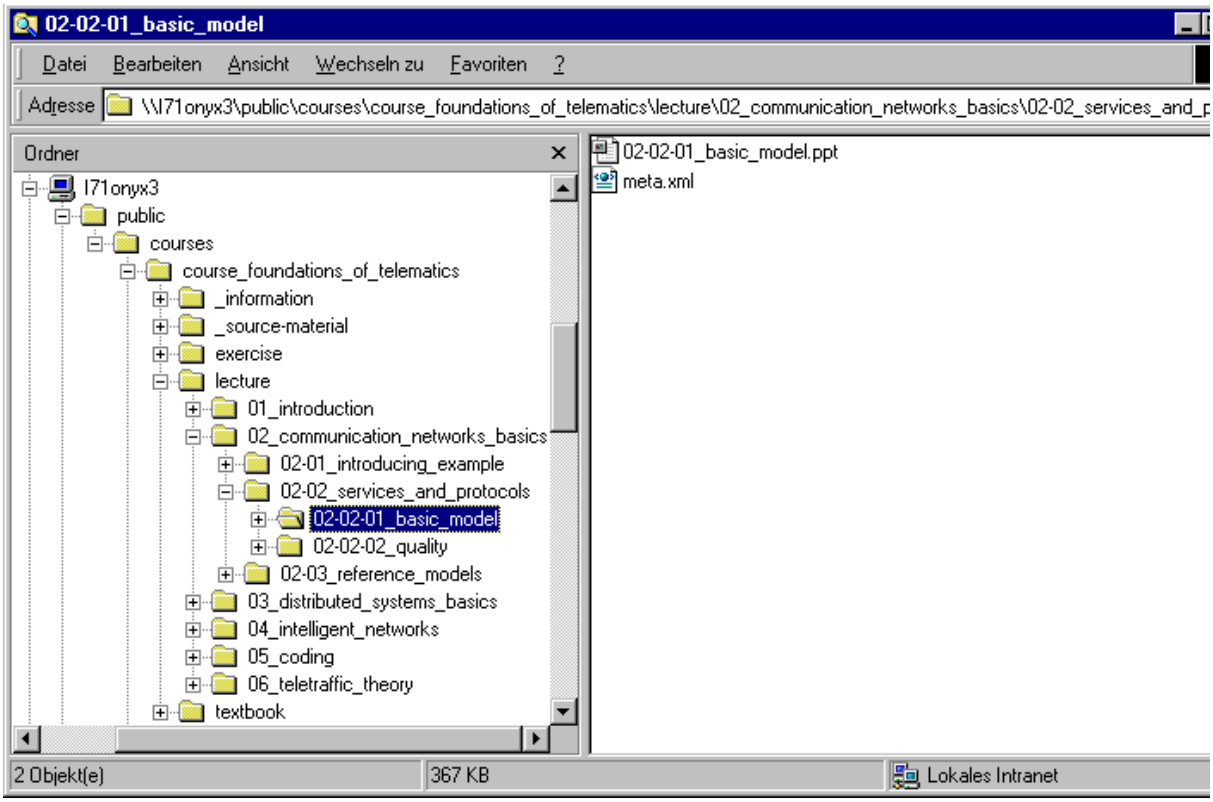

Figure 3: Example of a 'foundations of telematics' course

uted systems, *intelligent networks*, *coding* and *tele-traffic theory* [4]. Each of these topics may consist of a number of sub-topics; the topic *communication networks*, for example, may be divided into an *introduction*, an overview of *services and protocols*, and an overview of *reference models*. Within the CANDLE project a number of universities are working on common material for this 'foundations of telematics' course. The lecture notes of the course consist of powerpoint slides: one set for each sub-topic. In fact each set of slides that belong to a sub-topic, is regarded as a self-standing unit of material, which can be selected by other teachers, or not. To allow other teachers to get an understanding of what the slides are about, meta-data is associated with every set of slides. Figure 3 shows an example of how these slides and meta-data are currently stored within the repository. Note that the current version of the repository is still directory based; later versions will use the Oracle Internet File System and allow hyperlinked structures.

3.2 Internet Management Protocols

At the other side of the spectrum there are specialised courses, which are provided by only a limited number of universities, for students who have nearly completed their study. An example of such a course is 'Internet management protocols' [5]. This course consists of:

- Slides. There are more than 250 slides, covering subjects like the *history of Internet management*, the *Structure of Management Information* (SMI), *Management Information Bases* (MIBs) and the *Simple Network Management Protocol* (SNMP, versions 1-3). With this course all slides are in PDF format.
- Voice and video. Around ten hours of multi-media material exists, which can be seen via a 'Real player'.
- Interactive exercises. To allow students to obtain practical experience, a couple of interactive exercises have been developed. Students can access these exercise via web browsers, which communicate with a couple of PHP scripts that run on a customized web server. These scripts

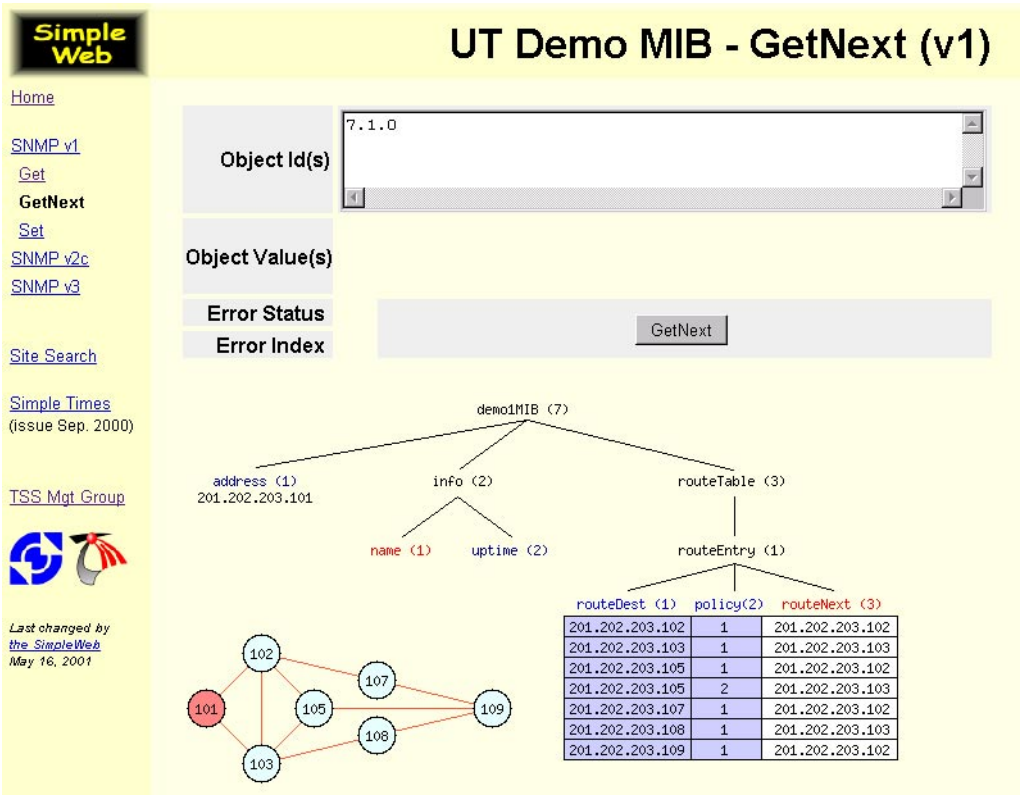

Figure 4: Example of executing a SNMP command

in turn access the agent software within special routers and other devices within our laboratory. One category of exercises deals with finding specific management information within these routers and devices. Another category of exercises demonstrate the parameters and errors that may be associated with the execution of SNMP commands. Figure 4 shows as example a screen dump of the *getNext* exercise. The bottom part of the figure shows a hypothetical network consisting of seven nodes; this network gives the context for this exercise. The bottom part also shows the MIB tree for one of these nodes (the left one, numbered 101). The actual SNMP command, including the parameters and possible errors, is shown at the top of the picture.

4 Methods

The third goal of the CANDLE project is to develop a couple of guidelines and methods to help the authors and teachers who will use the service, as well as the designers and implementors of the service. The ideas developed within CANDLE may also be interesting, however, for pedagogical staff and researchers in the area of teaching and learning.

This Section discusses two results of the CANDLE project in this area:
- Section 4.1 discusses how to annotate course material with meta-data.
- Section 4.2 introduces the guidelines for creating course material.

4.1 Annotating course material

Authors should annotate every piece of course material with meta-data. The meta-data model used within CANDLE [6] is based on the existing meta-data definitions of ARIADNE [7], IMS [8] and LOM [9]. In many cases there is a direct mapping between CANDLE meta-data fields and LOM v3.8 fields. The CANDLE meta-data model defines the following eight categories:
- General. This category describes the general characteristics of a piece of course material. It defines, amongst others, the title of the material, a description, the language being used, the author, his institution and contact information. There is also a field for the granularity level; this field takes one of the following values: c-atom, c-module or c-course (see Section 4.2).
- Lifecycle. This category defines the following fields for versioning purposes: version number, the ID of the previous version (predecessor), the ID of the next version (successor) and the date when the author last changed this version. There is also a status field, which may take the values ‘construction’, ‘evaluation’, ‘revision’ or ‘released’.
- Classification. This category defines semantical information that can be associated with the material. Such information can be described in terms of arbitrary keywords, as well as in terms of some well defined keywords. Such set of well defined keywords is called a taxonomy; within the project work has just started to define a (CANDLE) specific taxonomy for courses in the area of telematics.
- Pedagogical. This category describes pedagogical information. The selection of possible fields is based on research performed at the University of Georgia [10]. There are fields to define, for example, the support for cooperative learning, the type of learning environment, the ability to adapt to cultural differences, the importance given to ‘trial and error’ learning, the role of the teacher etc.
- Relations. This category is used to express possible relations with other pieces of course material. Besides identifying the other, related piece of material, it is also possible to express, for example, whether it is part of / the basis for / a reference to or referenced by the other piece of material.

- Technical. This category describes technical issues, like the size of the material (in bytes), the location (such as the URL), the MIME type, the operating system and browser requirements etc.
- Rights. This category defines, for example, whether the material is copyrighted, who is the publisher, what costs are associated with using the material etc.
- Meta-meta-data. This category provides information about the meta-data itself.

It should be noted that the first prototypes of the CANDLE system will support just a subset of the above meta-data. Lifecycle information, for example, will be omitted in these prototypes, as well as many fields in the other categories.

4.2 Guidelines for creating course material

To help authors who want to transform traditional learning material into web-based material, the CANDLE project has defined a couple of guidelines. The guideline document, which is called 'CREEM' [11], defines the following concepts: 'particle', 'C-atom', 'C-module' and 'C-course'. Since the idea of distinguishing between atoms, modules and courses is also found in other literature in this area, the character 'C' precedes these terms to denote their specific CANDLE interpretation.

Particles are pieces of course information that are stored in separate files. Examples of particles are: pictures (stored in, for example, JPEG, GIF or PNG files), PDF documents, powerpoint slides, interactive exercises (implemented, for example, as CGI scripts), movies (MPEG, DiVX, etc.), music (MP3, wav, etc.), speech and so on. It is allowed that particles 'include' other particles; examples of such particles are HTML files which includes GIF pictures. Particles may be stored on the CANDLE courseware repository, or on other servers on the web.

In case an author adds meta-data to a particle, the author creates a C-atom. C-atoms are in fact the smallest pieces of reusable learning material, and can not be decomposed into other C-atoms.
It is allowed to take several C-atoms together and associate new meta-data with this set of C-atoms. The resulting structure is called a 'C-module'. The process of taking together several small pieces of material and attach new meta-data to it, is in fact a recursive process. It is therefore possible to create from any mix of particles, C-atoms and C-modules a new, extended C-module.

C-courses are in fact special cases of C-modules, in the sense that they include also course specific information, such as the credits and the time plan. Figure 5 shows the containment relationship between C-courses, C-modules, C-atoms and particles.

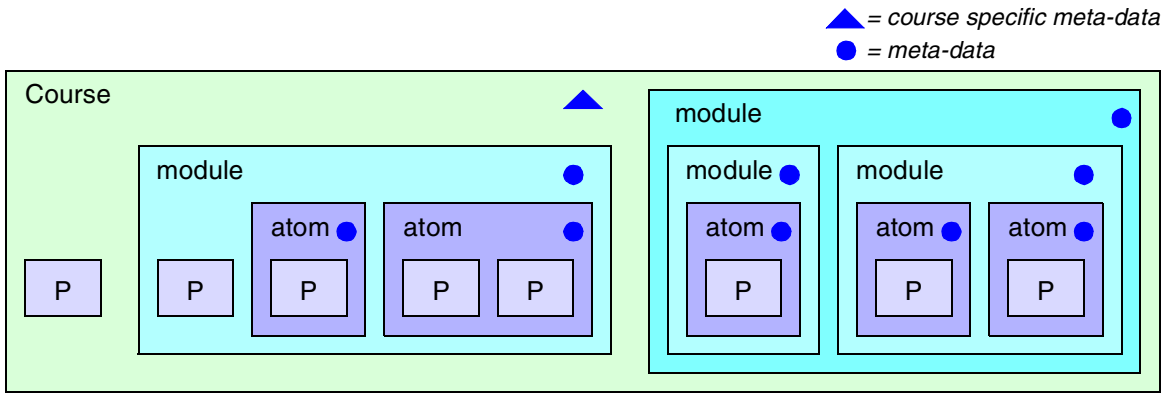

Figure 5: Containment hierarchy of particles (P), atoms, modules and courses

5 Conclusions

This paper discussed the main goals of the CANDLE project, which are:

- The provisioning of an open courseware service. This service can be used by authors as well as teachers, but is not intended to be used directly by students. The service will become available to EUNICE institutions in the summer of 2002.
- The creation of a set of open courseware components for telematics courses.
- The definition of methods and guidelines. At this moment their is a method for annotating course material with meta-data, and there are guidelines for transforming traditional course material into reusable web material.

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This paper presents the status and directions of the CANDLE project, as seen by the author. Although the author could not check his ideas with every other project member, the main ideas presented in this paper were developed at the last CANDLE Work Package 8 meeting, which took place on the 3d and 4th of May 2001 in Karlsruhe. I would therefore like to thank all people who participated at that meeting: Lluís Guiterrez (Universitat Politècnica de Catalunya), Rolv Braek (Norwegian University of Science and Technology), Sebastian Abeck, Karsten Krutz, Oliver Mehl, Christian Mayerl and Nadine Schmidt-Mänz (all University of Karlsruhe).

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