CDAC Cloud IP Store: A Repository for your Intellectual Properties

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Abstract— There are thousands of organizations and large corporates involved in research and product development, which generate a huge number of different varieties of intellectual properties (IPs). Once these organizations reach a certain level of maturity, it becomes very important to organize and categorize different IPs. In this paper, we describe C-DAC Cloud IP Store, which is a SaaS (Software as a Service) repository for the intellectual properties generated by an organization. This SaaS can be accessed through the Internet or the intranet, through a web-based graphical user interface. In the current version, it allows to store and index the patents, publications, software, trademarks and copyrights generated in the organization. Cloud IP Store allows storage, tracking, modifying, retrieving and searching of IPs. Role-based privileges for different categories of users are supported, that can be enabled or disabled. Multiple versions of Software IPs can coexist in the Cloud IP Store as the SaaS offers a versioning mechanism/ version control feature; we believe that this software will be of immense use to organizations to build on their abilities and strengths. The OpenStack Swift-based cloud storage is provided in the backend. The cloud technologies employed in this SaaS enables the scalability of storage, increased availability, fault tolerance, and ubiquitous access from anywhere in the world, all of which are critical to efficient utilization of this tool to improve organization-level productivity.

Keywords— *C-DAC Cloud IP- Store, Intellectual Properties, Patents, Publications, Product*

1. Introduction

The remarkable growth in scientific and technical knowledge in the recent years is leading us to the knowledge driven economy. Amongst the many success indicators in Business, Research or Academia is the creation of Intellectual Property (IP) [1] and its management; which eventually aids in building capabilities of any organizations. One of the key outcomes of Research and Development (R&D) organizations, Scientific communities and Academic institutes is the tremendous speed at which the Intellectual Property (IP's) have been generated. The need of the hour is to track, manage, store and protect the Intellectual Properties, the vital element of intellectual assets of any such organizations.

Cloud Computing [2] is a remarkable succession in the delivery of Information Technology (IT) and Services. The core of Cloud Computing is the access to a collective pool of compute resources whenever required without any intervention or hassles that can be scaled dynamically and metered, thereby offering convincing advantages in speed, agility and efficiency. With the advent of Cloud computing, many organizations can now outsource these IP's into the cloud; thereby necessitating the need for comprehensive storage solution for IP. C-DAC [3] aims to take Cloud Computing into academics and research organizations, so they can reap the benefits of omnipresent technology.

C-DAC offers Cloud IP-Store to enable organizations to build IP repository in simple steps. The cloud storage is intended for virtualized computer environment. The most popular open source software platform in Cloud Computing domain, OpenStack [4], consists of interrelated components that control large hardware pool of Compute, Storage, and Network resources throughout a Data Centre, which is handled through a dashboard or via the OpenStack API. Software as a Service [5] (SaaS) is a software distribution model in which a third-party provider hosts applications and makes them available to customers over the Internet. The IP Store uses SaaS repository model for the intellectual properties which generated by an organization. This SaaS can be accessed through the Internet or the intranet, through a web-based graphical user interface. Cloud IP-Store uses the Object Store implementation [6] of OpenStack Swift [7] as its foundation. Swift is highly scalable and redundant; well-suited for managing Peta-bytes of storage. OpenStack Swift distributes the storage across multiple Data Centres and provides unified accounts for the users. Cloud IP-Store manages various versions of IP's efficiently and the users can access the latest version of the IP.

The dissertations of this paper work are mentioned as follows: section 2 describes about the different related works on IP Management tools. Section 3 describes the need for the IP-Store. Section 4 explains about the architecture of IP-Store and its various components. Section 5 explains various features and screen shots of the IP-Store, section 6 provides information about the challenges faced during the development of this tool and section 7 concludes along with providing brief description about the future works.

2. Related Work

Ling Bei et al. [8] proposes software IP management process for developing software products, using third party software/ tools, open source software and proprietary components. We have to ensure the third party tools used in the development process should be legally obtained, acknowledged and documented. The IP management process improves the methodology

for verifying the software development, complies with the approved licensing and other aspects. Gouri G et al., [9] states that the Intellectual Property Management (IPM) is a multifaceted discipline. Many organizations, industries, and firms have realized the need to integrate this tool with their business strategy for effective utilization of IP through a robust IPM. Management of IP is undergoing major changes and gaining rapid recognition.

Xianggang Hua et al [10] opined that the universities form the crux of knowledge assets, subject categories, innovation ability and human resource. The theoretical approach to the scientific research and technological development at the universities is one of the important aspects, especially in the independent Intellectual Property Rights of the majority and produces the maximum outputs in terms of Patents and Publication. IpFolio [11] is an end-to-end IP management solution for collaborative IP management software targeting corporate IP groups, bringing together the inventors and managing IP portfolio strategically. It is a web-based tool built on Force.com [12], with stringent standards for privacy & security.

PATTSY [13] uniquely combines an efficient, easy interface with sophistication to manage complex IP scenarios. The dashboard displays the retrieval and access to   information intuitively and easy. From deadlines to upcoming actions for supporting data, every detail associated with the content is accessible in an instance. Combined with automated docketing, e-mail generation and a host of other features, PATTSY accomplishes in minutes what would otherwise take hours to accomplish manually. WebTMS [14] is a trademark management suite that builds on record keeping and docketing to help trademark management. The feature includes Trademark Record Keeping, Docketing and Diary System and Trademark Management. Patricia's IP Management is a customizable IP Management Software and accessible through Client/ Server as well as through the Web product that provides on-click access to data and tracking of relevant IP

FoundationIP [15] is an intelligent hosted solution; where the user does not have to install and maintain hardware. Business firms and innovators require easy, cost-effective solution to secure their inventions, brands, and designs across multiple countries. WIPO [16] offers a range of global services for protecting Intellectual Property (IP) across borders, and for resolving IP disputes outside the courts.

3.   Need for IP-Store

Intellectual Property management system is required to simplify and optimize the process of development and maintenance of any Software Products, Patents, Publications, etc. In this perspective, IP-Store is essential for management of IPs in any organization, such as research or academic institute. The various categories of IPs supported in IP-Store are listed below.

Software Products: For development, versioning and maintenance of software products or tools, the user requires a centralized facility to access the information and contents of the tool. The IP-Store is one of the best choices for the software developers and technical lead to know about the information and status of their products, thereby enabling collaborative efforts across the organization.

Patents and Publications: Any group or individual in an organization can securely store their IP information at the centralized location during the process of from submission to approval of the IP's. The IP-Store helps the decision makers of the organization with the information regarding the Patents and Publications, theme wise and time period wise through the web interface.

Trade Mark and Copyrights: Developing and managing the Trade mark and Copy rights are one of important activities of the software industry. There is a need to consolidate and maintain these information in a highly secured storage and also should meant only authorized person.

4. Architecture

The proposed project aims to provide centralized facility for storing and accessing the Intellectual Properties generated by multiple groups at various locations of an organization. The architecture and the components of Cloud IP-Store are shown in the Figure 1. Apache Tomcat [17] acts as the Application Server to host Cloud IP-Store Web Application. The users have to authenticate with their organization credentials. The IP is uploaded to OpenStack Swift using IP-Store API. On successful uploading of IP, the IP shall be stored in MySQL [18] database. OpenStack Swift is used for Object storage, where data is stored in the form of Objects and the Objects are stored in the Containers. Cloud IP-Store supports the following IP types, such as Publication, Patent, Software, Copyright and Trademark. Cloud IP-Store supports features like Update, Upload, Download and Search of IPs to the user.
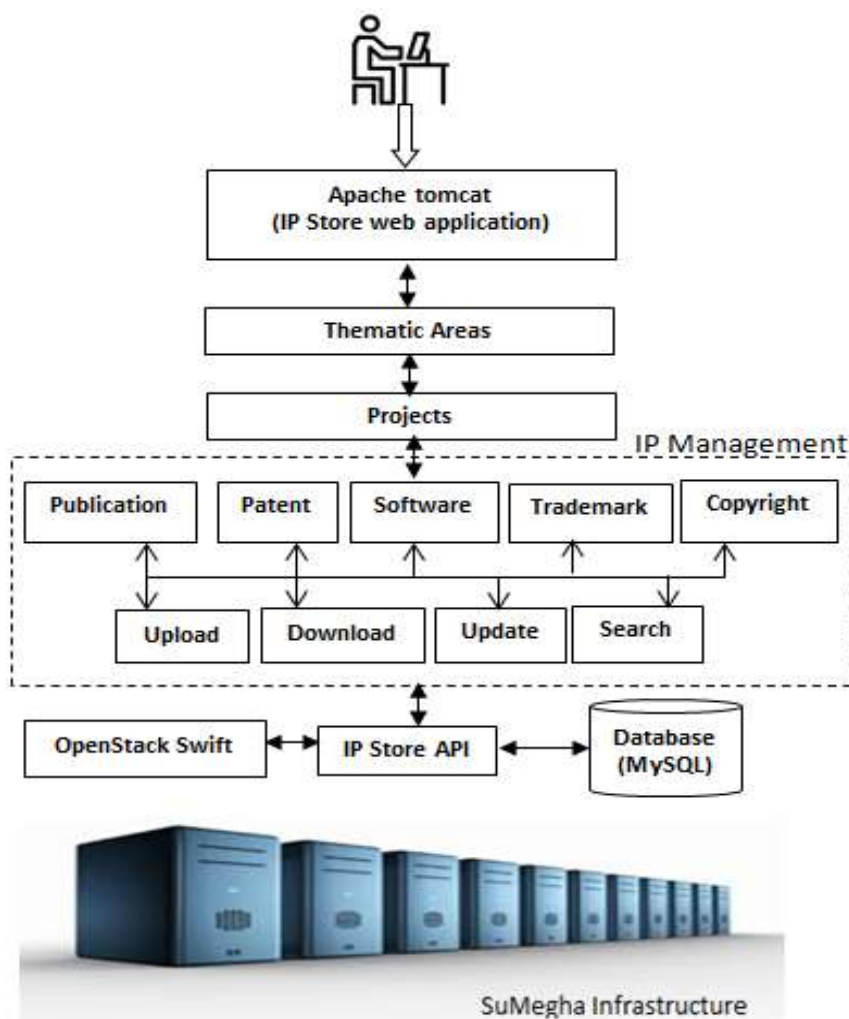

Figure 1: Cloud IP-Store Architecture Diagram

To upload IP, the user has to *Create Project* under which the IP should be and it should be under the thematic areas. Once project is created, user need to select the created project followed by selection of IP type. Here IP type can be publication, patent, software, trademark and copyright. Based on the selected IP type, appropriate information of that particular IP type should be provided by the user. The IP information and its related documents are stored in MySQL database and OpenStack Swift respectively using IP Store API.

The data is stored in the OpenStack Swift in the form of objects, which in-turn is stored in the Containers. The concept of two containers is used, namely "*CDAC_container*" and "*CDAC_Backupcontainer*". By default, the latest IP's are saved in *CDAC_container* and previous versions of Product IP's with corresponding time-stamp are saved in *CDAC_Backupcontainer*.

Timestamp is converted into standard time for managing the object file versions. Multiple versions of Software IPs can coexist in the Cloud IP Store as the SaaS offers a versioning mechanism/ Version Control [19] feature. After successful uploading of the IP, it is listed in the *Download section*, which can then be downloaded using IP-Store API. User can search for availability of IP's for information or to avoid duplication in the IP-Store. User can update IP's information using Update feature. By default, during upload, the user shall be displayed all the IP's uploaded by him/her. The option ALL displays all the IP's present in Cloud IP-Store. There is no restriction for downloading IP; anyone in the organization can download any IP.

Object versioning is a feature supported by OpenStack Swift. It is one way in which a user can store documents that might change [20]. You can store multiple versions of documents so that you can recover from document overwrites. Object versioning is an easy way to implement version control. It allows users to upload multiple versions of same file. With versioning, user's current data can be always available with active container, and all previous data will be available in backup container as shown in below figure 2.
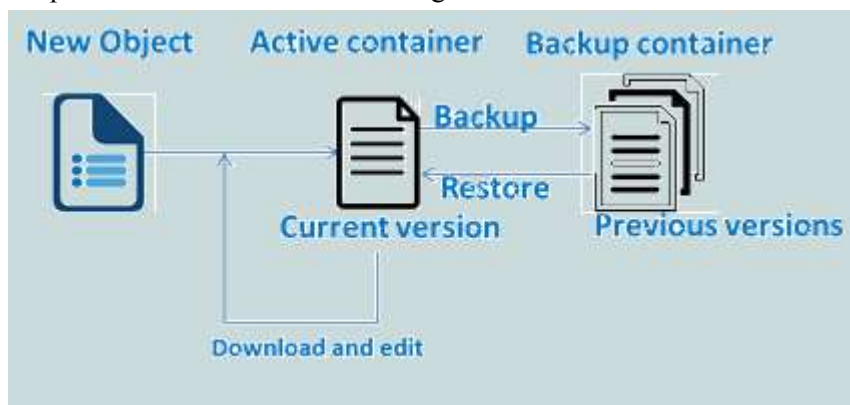

Figure 2: Object Versioning Implementation

You can restore an archived object at any time. When a file with same name as an existing file is saved to the active container, the old file is moved to backup container with timestamp appended to the file name. Here timestamp is associated with version number. Downloading file is based on timestamp and version. Versioning in OpenStack swift is controlled and managed at container level by setting the appropriate header [21].

Cloud IP-Store is deployed on SuMegha Cloud Infrastructure and all the IP's are stored in the SuMegha Cloud Storage. SuMegha Cloud is C-DAC Scientific Cloud [22] which provides on demand access to Compute, Storage and Network services.

5.   Features

Cloud IP-Store supports storing of Patents, Publications, Software Products, Trademarks and Copyrights as the Intellectual Properties in centralized Cloud storage. The Software Product IPs supports versioning mechanism, where in different version of the Software Products can coexist. During the configuration of the tool, the administrator can define the Thematic Areas required for their organization. We shall discuss the features of Cloud IP-Store in the following section.

    a.   Upload IP: The user should select the Thematic Area, Project Name and type of IP before uploading. Depending on the IP type, the respective form fields for that IP type shall be displayed. For example, if the user has to upload *Publication*, as shown in the Figure 3, the details like Conference Name, Title of the Technical Paper, Author, Co-authors, if any, Date, National/ International Conference and IP Name has to be keyed in, along with the IP to be uploaded. If IP type is *Patent*, the relevant information pertaining to the IP like Description of the Patent, Patent Application Date, Patent Approved Date, Current Status of the Patent, Scope of the Patent, Contact Person, and IP Name has to be provided. Similarly, the user has to enter the details relevant to IP type - Software, Trademark and Copyright. Upon uploading of the IP into the Cloud IP-Store, the "Successful upload" message for the IP type is displayed.

Figure 3:   Upload IP to Cloud IP-Store

    b.   Update IP: After the IP is uploaded to the Cloud storage, the IP information can be updated/ modified at any point of time. The user has to select the IP Name which has to be updated and overwrite the existing information. Cloud IP-Store supports object versioning with the concept of two containers, the main container and the backup container. Versioning is applicable for the Product/ Software IP only. To update the Product IP, the user has to mention its Version number. The original

Product IP will be moved to the backup container and the latest Product IP shall be stored in the main container. The main container always houses the latest version of the Product IP.

c. Download IP: Anyone can download an IP, once it has been uploaded in Cloud IP-Store. The *Download Section* displays only the IP's uploaded by that particular user, by default. If the user wants to download other IP's, he has to choose the ALL option, provided on top or select the required Thematic Area. The output displayed contains the IP's information segregated by its type with the respective radio button provided for each IP type. User can now select and download the IP required.

d. Search IP: The centralized search is available in *Download Section* and on the top right most corner. User can search IPs based on IP Name or User Name. This is a useful feature, as the user can search for duplicates, if any, before uploading their IP.

e. Software Versioning: Cloud IP-Store supports Product/ Software versioning. During the Product IP upload, the tool requests for its Version Number along with other details. While updating the Product IP, the tool asks only for the Version Number under the same IP name, but the source will differ. Currently, we are using OpenStack Swift to support versioning. While downloading the Product IP, the user can choose amongst the list of available Product versions, if any, from the pop up menu, as shown in Figure 4. Product downloaded is in one of the following formats, zip, 7z, tar, tar.gz.
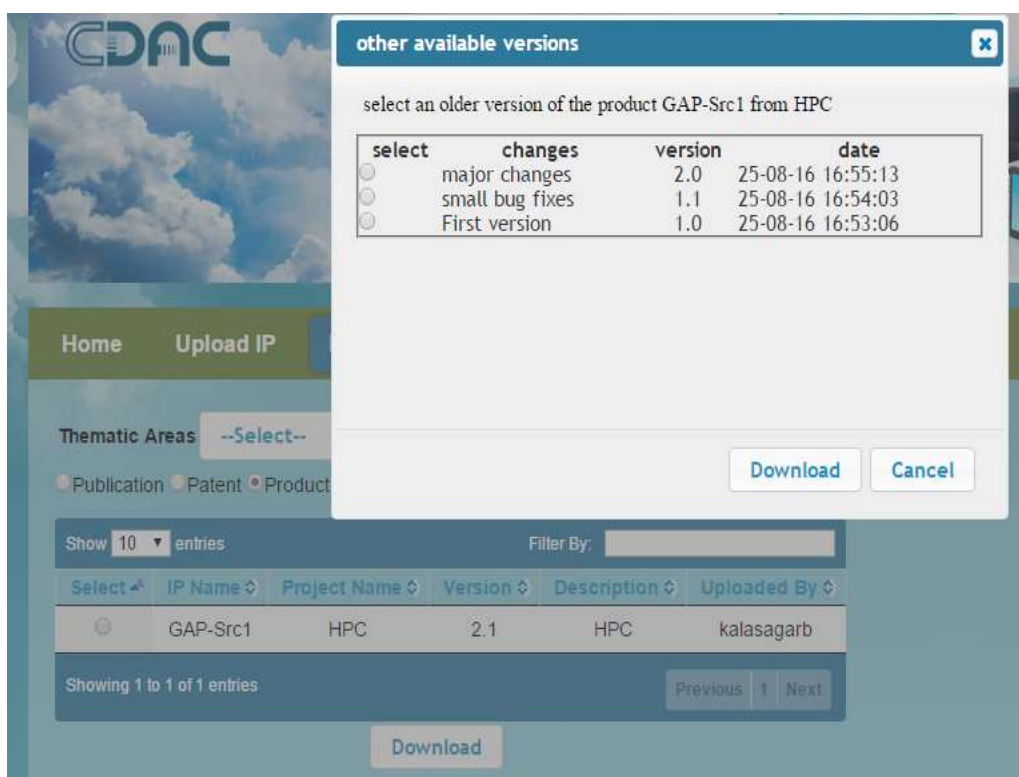

Figure 4:   Software Versioning

f. View IP's before download: User can view the IP content before downloading in the *Documents section*. This feature helps users to ensure that the correct IP is being downloaded. The respective images are displayed for Copyrights and Trademark IP's by clicking View Image button.

6.   Comparison of features with other IP management tools

Table 1 captures the significant features of the popular IP management tools and a comparison with CDAC Cloud IP Store. CDAC IP store is specifically designed for IP management of organizations, for storing and retrieving the IP information internally. It is a centralized storage management system and exclusively for handling IP related documents within the organization. It has nothing to do with filing and monitoring the status of the Patents, Trademarks etc. Due to this reason, features like monitoring the IP status, comparison of IP with online repositories and Reports & Dashboards features are not supported in CDAC Cloud IP Store.

Name of IP tools	Project Management	Monitor	Search	Access control Public/private	Comparison of IP with Online Repositories	Report& Dashboards
Cloud IP Store	Yes	No	Yes	private	No	No
PATTSY	Yes	Yes	Yes	public	Yes	Yes
Web TMS	Yes	Yes	Yes	public	Yes	NA
WIPO	Yes	Yes	Yes	public	Yes	NA
Foundation IP	Yes	Yes	Yes	public	Yes	Yes
IpFolio	Yes	Yes	Yes	public	Yes	Yes

Table 1: Features Comparison

7.   Challenges Faced

We encountered several challenges during the design and development of Cloud IP-Store. In architectural design, the major concern was the whether to include the organization hierarchy, across various teams and designations, for accessing the IPs. Currently, Cloud IP-Store supports both the versions where organization hierarchy is considered for accessing, uploading, updating and downloading IP's or the version where anyone can access any IP.

Another challenge confronted was the Software versioning. We chose OpenStack Swift as a Cloud Storage solution, as it supports Object Storage Versioning. Object versioning requires two containers i.e. the main container *CDAC_container* and the backup container *CDAC_Backupcontainer*. We faced few glitches in linking the two containers for the backup of files. The issue was resolved by creating the authentication token produced by *curl* command. The key point is storing the files with name followed by the timestamp in the backup container, even after linking two containers. To identify the various versions of Software Product, the timestamp is converted into the IST time.

8.   Conclusion And Future Work

A single point web access to all the Intellectual properties generated by an organization is essential, as it avoids duplication of effort and ensures timely access to the IPs by all concerned. The Cloud IP-Store tool would assist the management; say in identifying the number of Intellectual Properties generated in a specified time period, IP content, subject experts within the organization, etc. The authors have pointed it out as a useful feature. Currently, we support 5

types of IP's, viz. Publications, Patents, Products, Trademark and Copyright; we plan to support more types of IPs in next versions of Cloud IP-Store. At present, the underlying platform used is OpenStack Swift Storage; we intend to support diverse storage systems, to enhance the interoperability of the software. We plan to provide support for traditional non-Cloud-based storage systems in future. The current version supports generic username and password-based authentication mechanism and is integrated with C-DAC's Single Sign On mechanism. We intend to explore providing support for various other authentication mechanisms such as Open ID, generic C-DAC-based authentication, and certificates. In the next version of Cloud IP-Store, we plan to support encryption for better security, for both static data and data in movement. The scope of the Cloud IP-Store can be further extended to include even future planned developments for IPs in software product, thereby enabling a tracking mechanism within the tool. Further, some changes may get necessitated through user feedback.

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