Digital Intellectual Property as a Service (DIPaaS): For Mobile Cloud Users

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***Abstract*—with the integration of cloud computing, smartphones enormously improved in processing power, storage, communication efficiency, and reliability. The technical architecture of Cloud strongly supports the efficient delivery of services in mobile environment. Whereas the mobile cloud users can access all the resources as a service dynamically in elastic mode. Accessing Digital Intellectual Property as a Service (DIPaaS) on flexible economic basis is a major interest among the mobile users. DIP is the piece of work of human intellectual in digital form such as eBook, software program, e-painting, movie, song, computer game, and etc.,. The DIP services complex in nature; involves creator, manufacturer, distributor, licensing agencies, and service providers. However, the service limitations exist, shall be overcome with an understanding approach to Service Level Agreement (SLA). DIP applications consume a large of local resources and could not be implemented on standalone mobile phones. Therefore, we realize increasing demand for an efficient service-model which satisfies the mobile cloud users at large. We proposed the first service-model includes both technical and service architecture to encourage the stakeholders for DIP access in mobile cloud environment. Eventually we present an efficient access to Digital Intellectual Property as a Service in Mobile Cloud Environment (DIPaaSMCE).**

Keywords-Digital Intellectual Property; Mobile Cloud Computing; Service Oriented Architecture; Service Level Agreement.

I. INTRODUCTION

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models [1]. Offers software and processing power; provides platform for application's developers and a vast variety of storage over the Internet on demand to its consumers. Also maintains higher level consistency; reducing cost and providing flexibility and mobility of information. Cloud technology is not only limited to the desktop computers, it also has been influencing other technologies; specifically an intense impact on mobile technology. Resources of cloud are in fast way of converging into a new rapid emerging field described as Mobile Cloud Computing (MCC or MC2). In the cloud platform resources for example Google AppEngine, Amazon EC2 and Microsoft Azure can see mobile cloud computing as new paradigm for mobile applications [2]. The rapid growth of heterogeneous cloud services and the integration to mobile technology influences the service delivery-model of Digital Intellectual Property (DIP). DIP is any unique product in digital form created or invented of the human intellectual and has commercial value. Examples of DIPs are computer programs, specific databases, eBooks, research creations, e-Paintings, movies, songs, and any unique piece of human intellectual work in digital form. Since last decade DIP has been offering as a service to the subscribed ecommerce users in desktop environment. These users are limited and restricted to the defined subscription(s). Whereas a cloud user is privileged to access a scalable range of cloud resources on demand especially DIP products. The demand for an efficient access to DIP in mobile environment is also increasing; requires more infrastructural resources to meet users' satisfaction. Mobile devices are limited in resources such as processing power, storage, and the battery life. These limitations can be overcome along with the integration of cloud technology. The huge benefit of this integrated technology is that resource-limited device is transformed into resource-rich environment. Processing heavy applications on mobile devices may not be constrained for the users. Ecommerce giants such as Amazon, Google, PayPal, and many more are highly convinced the impact of cloud service infrastructure, delivery-model, consistency, reliability, and economic-model. The ease of integration to mobile network further attracts the academia and industries. Most of the IT large scales organizations such as Google, Microsoft, and Cisco have already build their cloud infrastructure for mobile users. The integration nature and efficient service-delivery model of cloud advances it to the new heights of computing and communication paradigm; specifically in mobile environment. Figure 1, describes an abstract view of service-request model to cloud based DIP resources in mobile environment. When a subscribed mobile cloud user requests an application to the pool of DIP databases in the cloud; if the request is authenticated then the system admission control module consults the system resource management module about the availability of requested application(s). The application may be for any field of DIP products discussed earlier in this section. Each DIP database is a

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portion of cloud system resources; if the requested application is available, then it will be allocated by the system resource management module. In this way the users can access any application of DIP products on their mobile devices.

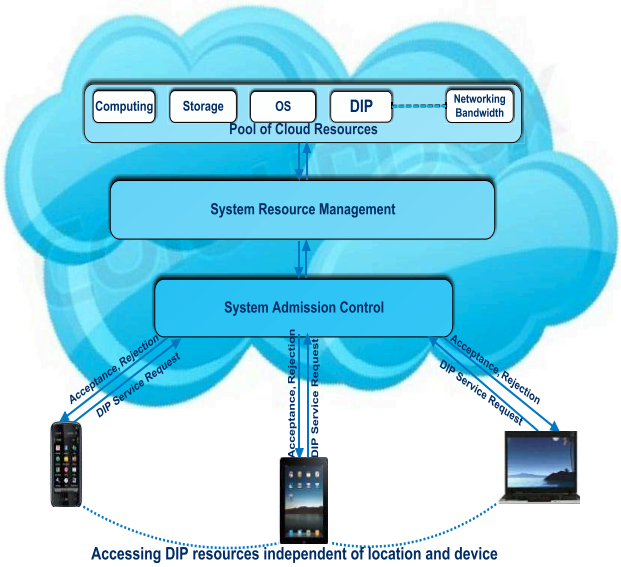

Figure 1. IP Service-Request Model in Mobile Environment

We present an efficient access to the cloud based DIP resources as a service in mobile environment. Our novel approach is to analyze both cloud service infrastructure and the integration to mobile network. This makes possible for an efficient access with a single interface; over the internet on pay-as-you-consume. We investigated the existing one and proposed new service dimension by name Digital Intellectual Property as a Service in Mobile Cloud Environment (DIPaaSMCE). An efficient access to DIP as a service in mobile cloud environment needs to organize in rest of the way. Section II we discussed the technological composition and organizations' approach. Section III presents an access to DIP in mobile environment; further explains the mobile cloud architecture, service-architecture, service-modules, SOA for DIP, and benefits. Whereas Section IV discussed about issues and challenges faced for the service. Conclusion and future work indicated in Section V.

II. DIP TECHNO-LOGICAL COMPOSITION

Intellectual property refers to rights in creations of the human mind which arise under the laws of patents, copyrights, trademarks, trade secrets, unfair competition and related laws [3]. IP such as books, paintings in digital form is known as DIP, or any unique product in digital form, created or invented of the human intellectual and has commercial value for which a set of exclusive rights are recognized and the corresponding fields of law. DIP could be better understand by the technical aspects and attributes of IP; the adoptability to new technologies such as cloud and mobile cloud.

A. Selecting a Template (Heading 2)

The world has become highly interconnected. Technologies keep on evolving, integrating and advancing into new paradigms. Developments of IT such as Internet, Web, Cloud, and Mobile Cloud have changed the service domains and the delivery model of IP to its users. Previous copyright code, ethics, and laws no longer fit in to this environment. Many DIP consumers have different opinions of piracy when it comes to DIP files for sharing and downloading. Some see it is an obvious infringement of copyright law, others believe ownership is more complex and expensive.

IP in digital form are accurately computable and perfectly reproducible; not just once, but an infinite number of times; no degradation in processing performance, and no limits to duplication of copies. Every single copy of digital components is to be appearing as original one. Compression of DIP products is achieved; animations, paintings, and cartoons have been digitized with digital computations. The advancements of integrated technologies enable developers and users to create, access, store, transmit, and manipulate DIP product at their ease. The potential ability of internet is to widely distribute digital works faster and less expensive than any other means and able to communicate to millions of people [4] along with downsides that contents owners have a little control over the subsequent dissemination and use of their work. It also damages the economic interest for those who create the DIP. Consumers can easily send and receive DIP products on the internet for free, and abolishing the interest of DIP stakeholders. DIP as a service is getting more popularity with the rapid growth of heterogeneous mobile networks and emergence of cloud technology. Technologies must explore the abilities to transfer contents, the potential to protect DIP in all formats, and rights of owners.

B. Organizational Approach

Organizations of different fields and domains reshaped their architecture to information age and meet the business requirements of digital and communications industry. The approach of organizations ensures that all the stakeholders of a DIP cohesively achieve the required common goals. For an efficient access of DIP, various organizations have necessary to play significant roles in the respective domains.

1) Academic and Research Organizations: These organizations are at the forefront of research domain in respective fields; inventors of new technologies; prominent in advanced research, and have been contributing to the scientific research. The functional structure of these organizations is to produce the intellectual products; protect the interest of creators, inventors, and researchers in all aspects. Technology providers and users at technology's "bleeding edge" need researchers who have the focus,

intellectual energy and spirit of innovation to provide pre-market development services [5]. Organizations such as Elsevier, ACM, IEEE, Universities, and many more allow access to the respective DIP databases on specific subscriptions. The subscribers have privileged to access digital libraries, journals and research papers of different scientific domains. The adoption of Cloud technology enhanced presidential growth in offering the DIP services. Service providers maintain cohesive relation with these organizations on predefined business model and bound to follow Service Level Agreement (SLA).

2) Ecommerce Organizations: Ecommerce refers to buying and selling of products or providing services of intangible products, often over the Internet and other computer networks. According to Michael Aldrich, Online shopping is a form of electronic commerce where the buyer is directly online to the seller's computer usually via the internet. The widespread usage of internet and emergence of new service-centric technologies influenced ecommerce organizations such as Amazon, eBay, Alibaba.com, Apple.com, Wal-Mart, and many more to restructure the delivery and service model of intangible and specifically DIP products. An increasing demand of DIP as a service; organizations have already updated the DIP databases and continuing the same with the track record of consumers' request and demand. In the recent past, it has been proven that, this is the best form of business model for achieving high performance business growth. A recent report published by comScore Inc., a leader in measuring the digital world suggests that Amazon Sites reached the largest global audience with more than 282 million visitors in June, i.e. 20.4 percent of the worldwide Internet population [6].

3) Business and Entertainment Organizations: These organizations have been producing the major amount of DIP products worldwide on different means. Entertainment industry is dynamic in nature; produces DIP products such as movies, songs, animations, and tec. Writers, directors, producers, music composers are the main source and stakeholders; highly concerns of security, piracy and malicious use of their hard earned DIP. Whereas the consumers are knowingly or in the state of confusion involved in pilferage activities; damages the interest of DIP creators.

C. DIP Resources

As the world has transformed into information-hub and connected globally on the edge of advancements in technologies. Eventually there is an increasing demand of information sharing and efficient access to different DIP products, specifically after the implementation of social networking sites. DIP access as a service through a wide variety of platforms and devices over the internet has become the global trend. Generous consumers are highly interested of having access to these resources on-demand, 24X7, irrespective of location and mode of access. DIP products create, monitor, manage and control by organizations such as business, entertainments, academic and research in general and e-commerce organizations in particular.

III. DIP Access in Mobile Environment

Recent advances in technologies, computing and communications have emerged as service-centric and are continuing in response to users' growing need. Mobile technology is among the top; whereas smartphone stands out vital and users demand for rich mobile applications are increasing. Today's mobile users expect efficient connectivity irrespective of location, specifically when engaged via social network. Also increase in demand of potential, rich, personalized, dynamic, intelligent, and quality service. Even they seek ubiquitous access to a vast range of multimedia-based contents in heterogeneous mobile environment. Recent studies show that DIP service providers upgraded their infrastructures and volume-up the databases in response to huge service demand. Cloud computing has been emerging as a potential service-centric technology and providing resource-rich environment for many media-rich DIP applications.

The essential and important components of DIP access architecture is discussed as under.

- **3G Gateway** forms a bridge between 3G DIP requests from the mobile handset to the IP network that hosts the DIP components.
- **DIP Media Server** displays stored DIP files across the IP network. The media server uses an IP interface to enable integration with stream servers and to allow for IP-based DIP in the future.
- **Application Server** implements the actual user experience of the system by controlling the IP media server component. The definitions of channels, how to react when the user presses a key, and any interactive applications are handled here.
- **Content Server** stores the DIP files to be displayed and offers an interface for the content owners to upload their DIP. The files are sent to the IP media server as requested by the user. The content server and application server often will be combined into one physical system.
- **DIP Transcoder** converts a wide variety of possible DIP formats into one of the specific DIP formats that can be used for 3GM. This component is required when a DIP source is not in a format suitable for sending directly to a 3GM mobile handset.

- **DIP Stream Server** is used to transmit a live DIP stream (live video, stage play, live singing) to each user of that stream via the 3G-M gateways.
- **DIP Encoder** which takes DIP signals and encodes them into RTP streams. These RTP streams are then sent to the DIP stream server for further distribution to each user.

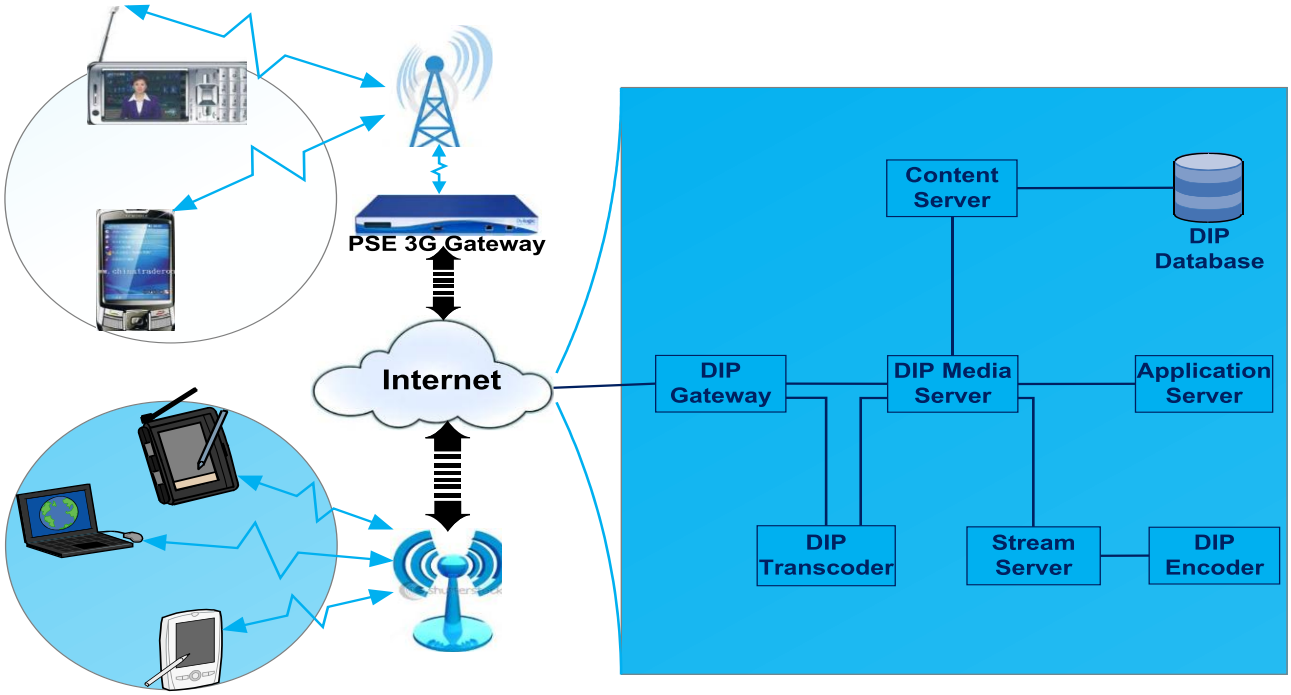

Figure 2. Architecture for DIP access in mobile environment

A. *DIP Mobile Cloud Architecture*

Mobile cloud is a combination of both mobile and cloud technology; it is integrated, evolved on the most dominating mobile and highly attractive cloud technologies. It refers to an infrastructure where both data storage and data processing happens outside of the mobile device [7]. It also defined as an extension of cloud computing with a new ad-hoc infrastructure based on a mobile device. Mobile devices can be seen as access-interface of cloud online services. Today, the subscribed mobile cloud users can access different fields of DIP applications; entertainment, research, and business through their mobile devices irrespective of time, location and mode of access.

MC2 is a centralized computing environment where mobile devices become a core component of mobile cloud computing architecture; applications executed in clouds and accessed over the wireless computing network through web browser on the consumer electronic devices. Mobile Cloud is different from cloud computing, and it is converging cloud computing, cloud networking, cloud services, mobile virtualization and open wireless architecture into one common platform [8]. It is bringing applications and mobile computing together for smartphone users and also for much broader range of mobile subscribers. MC2 architecture is gaining popularity for user-centric approach rather than carrier-centric mobile terminal device, especially for mobile Internet, mobile social networking and mobile service convergence, etc. The architecture is heavily relied on both cloud and internet technology. Cloud offers storage and processor in the way as it is an integral components of MC2. Users can upload or download any DIP product directly from their devices to and from the backend storage of cloud; access ambiguously in heterogeneous wireless-network environment. For DIP applications cloud performs heavy processing at scalable backend and the device acts as interface for the user. MC2 architecture offers a great advantage over traditional mobile computing; it minimizes the limitations of consumer mobile device. In practice, it enhances the computing power above the consumer device configuration when a heavy DIP application is in process; provides long life to battery by running such applications in the cloud. According to the current research, MC2 will be most attracting tool of accessing DIP product among enthusiastic users. Already there are some mobile cloud applications for example Google's Map, Gmail for iPhone and Cisco's WebEx on iPad, however these applications are using the Software as a Service model [2].

B. *DIP Service Architecture in MCE*

Mobile cloud service framework differentiated from traditional services in three ways: (1) Services are offered and sold on demand in time dimension. (2) Services are elastic in nature, means a user can consume as little or as

much of services at any requested time. (3) The services are fully control and manage at cloud side. The essence of MC2 is to provide any precise resource from the pool of IT resources and real time applications to any subscribed mobile clients at any time, and place. We will include servicer architecture in our future work.

IV. DIP ISSUES AND CHALLENGES

Today, the rapid growth of digital technology, coupled with increases in computing power and storage, and emerging service-centric model, creates global markets for DIP stakeholders. But it also creates more threats such as absence of adequate controls, inefficient protection mechanism, and lack of control on piracy; which will definitely damage the creative industries. The core issue is copyright of DIP. Sharing of information will inevitably involve the issue of keeping secrete and protection. In the construction of DIP, material resources should be collected, processed, integrated, stored, delivered and taken advantage. This directly involves the beneficial relations of the creator, inventor, author, transmitter and the public, which greatly challenges the protection of DIP. In the construction and dissemination, a series of laws were strictly followed to establish a standard working business model in most of countries across the world. In 1998, according to the regulations of the Treaties of the Law of the World's Intellectual Property and Organizational Copyright (WCT), Digital Millennium Copyright Act (DMCA) was formulated and issued.

A. Device Issues

Physical safeguard- it is the top most concern of the users, to protect the device.
Unauthorized access- it is important to prevent the device from unauthorized access.
Radiation- cell phone emits radiation, may have serious health effects and unhealthy.
Limited Resources- device has limited computing resources; it fails to process some high performance computing applications.
Usage- the use of location information opens-up an almost unbounded number of privacy issues.
Risk- of data loss and device software
Use- heavy use of mobile phones increases cancer risk!
Mobile Devices- for mobile users, it is sometimes a frustrating experience (Complexity, Layout, Size, Navigation, Content, Variation in mobile devices, Variations in networks)

B. Service Issues

Loss of connection or network availability- during mobility network connection between the client and service provider network might be lost.
Network Latency- low latency network connection is one that generally experiences small delay times.
Interception- of wirelessly transmitted data
Privacy issues- that arise from location-enabling technologies and their applications.
Retention issues- for location information concern what information is stored, where it is stored, how long it is stored, and how securely it is stored
Regulation- Regulation and control of location information may come from several sources.

V. CONCLUSION AND FUTURE WORK

This paper presents a novel approach for the access of DIP in a heterogeneous wireless-network environment. The proposed architecture is responsible for acquiring, processing, managing, and delivering DIPs. Mobile cloud users can subscribe a brand new application DIPaaSMCE to service providers and have the privilege of services anywhere, anytime, on demand; scale the various DIPs, and pay on consumption basis. SLA must be maintained in the defined legal framework; includes quality-service, the unity of fairness and efficiency, the co-ordination of providers and user interest so on. However, the implementation and efficient service offering will depend on the integration of service-technology, coordination of DIP providers with service-providers, and the subscribed users.

We intend to propose DIP access rights, service architecture and design an intelligent application which will provide the track-record of DIP consumers dynamically, their interest and future demand of DIP fields.

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