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Content Delivery based on Context and User Intelligence

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***Abstract*: Today's Internet content providers primarily use Content Delivery Networks (CDNs) to deliver content to end-users with the aim to enhance their Web access experience. We adopt a measurement-based approach to understand why, how, and how much CP-level intelligences can help content delivery. In contrast, knowing the exact context under which contents are consumed, CPCDN is able to exploit context intelligence capturing how contents are dynamically processed and synthesized in different contexts, to optimize the user experience and service quality along content delivery. In this paper, to go along with the rapid move to CPCDN, we apply a measurement-based approach to understand why, how and how much CP-level intelligence can help content delivery. Based on the crowd patterns, we proactively duplicate contents according to the interest groups so that users can get the contents they are interested in from nearby CPCDN servers. Leveraging the powerful user intelligence capturing how contents are dynamically shared and distributed among social-networked users, CPCDN is able to improve both the content delivery efficiency and user experience to the next level.**

***Keywords*: CDN: Content Delivery Networks, CPCDN: Content Delivery Powered by Context and User Intelligence, crowd patterns.**

1. Introduction

The Content Delivery Networks (CDNs) are broadly sent to enhance the execution, adaptability and security of web destinations. Cloud has already changed both business and everyday life from customers who perhaps unknowingly use it to access their favorite music to companies that purposely harness its powerful resources. [1] To more clearly determine how organizations use cloud today and how they plan to employ its power in the future, we surveyed, in conjunction with the Economist Intelligence Unit, 572 business and technology executives across the globe. However, our survey also indicates this will change dramatically in the next few years, with more and more organizations looking to cloud to drive new business and transform industries.

As Internet traffic continues to grow and web sites become increasingly complex, performance and scalability are major issues for web sites. Web sites are increasingly relying on dynamic content generation applications to provide web site visitors with dynamic, interactive, and personalized experiences. However, dynamic content generation comes at a cost each request requires computation as well as communication across multiple components. The complexity of scaling Online Social Networks (OSNs) has introduced new system design challenges that have often caused costly re-architecting for services like Twitter and Facebook.[2] The complexity of interconnection of users in social networks has introduced new scalability challenges. Conventional vertical scaling by resorting to full replication can be a costly scheme. The technique of horizontal scaling which partitions and distributes data among multiples servers - e.g. using DHTs - can lead to expensive inter-server communication. We design, implement, and evaluate SPAR, a social partitioning and replication middle-ware that clearly leverages the social graph structure to achieve data locality while minimizing replication. SPAR guarantees that for all users in an OSN, their direct neighbor's data is co-located in the same server. The gains from this approach are multi-fold: application developers can assume local semantics, i.e., develop as they would for a single server; scalability is achieved by adding commodity servers with low memory and network I/O requirements; and redundancy is achieved at a fraction of the cost.

Context awareness is a property of mobile devices that is defined complementarily to location awareness. Whereas location may decide how certain processes in a device operate, context may be applied more flexibly with mobile users, especially with users of smart phones. Context awareness originate as a term from ubiquitous computing or as so-called pervasive computing which wanted to deal with linking changes in the environment with computer systems, which are otherwise static. The relevant information to an individual may vary widely under different contexts. This allows us to build a more generic and adaptive system that automatically selects the most relevant content and presents it to the user in a brief manner that supports ease of consumption and comprehension.

2. Existing work

In existing system, Content distribution networks (CDNs) using storage clouds have recently started to emerge. When we compare traditional CDN's to cloud-based CDN's the cloud-based CDNs have the advantage of price effectively offering hosting services to Web content providers without owning infrastructure. However, the existing work on replica placement in content delivery networks (CDNs) does not readily apply in the cloud. In this paper, we investigated the combined problem of building distribution paths and placing Web server replicas in cloud CDNs to minimize the price incurred on the CDN providers while satisfying Quality of Service requirements for user requests. We develop a suite of offline, online-static and online-dynamic heuristic algorithms that take as input network topology and work load information such as user location and request rates. [6] We then evaluate the heuristics via Web trace-based simulation, and show that our heuristics behave very close to optimal under various network conditions.

Online social network is emerging as a promising alternative for users to directly access video contents. [4] By allowing users to import videos and re-share them through the social connections, a large number of videos are available to users in the online social network. The quick growth of the user-generated videos provides huge potential for users to find the ones that interest them; while the convergence of online social network service and online video sharing service makes it possible to perform recommendation using social factors and content factors jointly. In this paper, we design a dual social-content recommendation framework to suggest users which videos to import or re-share in the online social network. Here, we first propose a user-content matrix update approach which updates and fills in cold user-video entries to provide the basics for the recommendation. Then, based on the updated user-content matrix, we build a joint social-content space to measure the relevance between users and videos, which can provide a high accuracy for video importing and re-sharing recommendation.

The disadvantages of the existing are it is difficult, if not impossible, for conventional CDNs to leverage the inherent user-content preference pattern and user-user social influence to optimize user experience and service quality. This is not efficient for today's content delivery, where users show predictable preference of contents. This however has not solved the fundamental problem. It is not easy to query data stored as key-value pairs.

3. Proposed work

In this, the system presents the change of today's content delivery motivating content providers to build their own CPCDNs and the framework of a CPCDN, where content context and user information can be utilized for more intelligent content delivery. A content delivery network or content distribution network (CDN) is a large distributed system of servers deployed in multiple data centers across the Internet. The objective of a CDN is to serve content to end-users with high availability and high performance. CDNs serve a large part of the Internet content today, including web objects (text, graphics and scripts), downloadable objects (media files, software, and documents), applications (e-commerce, portals), live streaming media, on-demand streaming media, and social networks. Content providers such as e-commerce vendors and media companies pay CDN operators to deliver their content to their audience of end-users. In turn, a CDN pays ISPs, carriers, and network operators for hosting its servers in their data centers. This paper proposes CPCDN delivery strategies based on context and user intelligences. On one hand, it designs the content replication and the user request schedule strategies by knowing the importance of contents when they are delivered in different contexts; on the other hand, we let the CPCDN predict the popularity of contents that are shared among social-networked users, for better network resource allocation. Other purpose of this paper is to show that there are indeed potential benefits in exploiting CP-level intelligence in content delivery.

A CDN provides better performance through caching or replicating content over some mirrored Web servers (i.e. surrogate servers) strategically placed at different locations in order to deal with the unexpected spike in Web content requests, which is often termed as flash crowd or Slashdot effect. The users are redirected to the surrogate server nearest to them. This helps to decrease network impact on the response time of user requests. In the context of CDNs, content refers to any digital data resources and it consists of two main parts: the encoded media and metadata. The encoded media consist of dynamic, static, and continuous media data (e.g. video, audio, images, documents, and Web pages). Metadata is the content description that allows identification, discovery, and management of multimedia data, and also facilitates the analysis of multimedia data. Content can be pre-recorded or retrieved from live sources; it can be persistent or transient data within the system. The basic three components of a CDN architecture are – content provider, CDN provider and end-users. A content provider is one who delegates the URI name space of the Web objects to be distributed. The origin server of the content provider holds those objects. A CDN provider is an organization or company that provides infrastructure services to content providers in order to deliver content in a well-timed and reliable manner. Clients or End-users are the entities who access content from the content provider's website. The CDN providers' uses caching and/or replica servers located in different geographical locations to replicate content. CDN cache servers are also known as surrogates or edge servers.

The advantages of proposed paper are: Our measurement study also shows that certain social behaviors among online social-network users have great impact on whether contents will become popular, and if so, among which group of users. The idea of CPCDN can significantly improve conventional CDNs for context-aware and social content delivery. The CPCDN is able to utilize the context intelligence and user intelligence to not only optimize the under-layer content delivery strategies, but also improve the understanding of upper-layer content characteristics. CPCDN strategy can schedule the requests to servers well according to their capacity and loads, so that servers will not be overwhelmed by the requests.

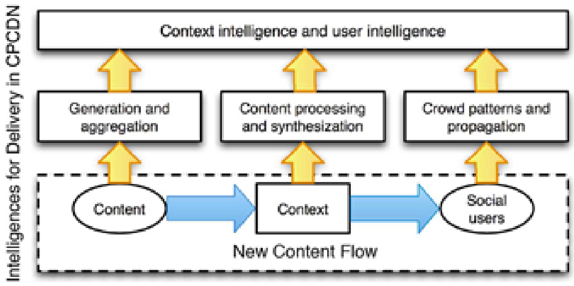

Fig. 1. CPCDN powered by intelligences mined from the new content flow.

4. Conclusion

The measurement-based evaluations demonstrate the effectiveness of CPCDN design as compared to the conventional CDN approaches as follows: the webpage load delay is reduced by context-aware request schedule, the local download improvement is achieved when the crowd patterns are considered in content replication; and a significant improvement is achieved in the prediction of popular social contents that attract flash crowds. In a CPCDN, the social relationship and social activities of users allow the new design space to explore how the make use of the user intelligence for content delivery.

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