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## Content Management System

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**Abstract:** Content delivery is a fast emerging technology. It is growing rapidly as a complex systems domain concerned with multi-channel, multi-format publication of information across user and application platforms. A variety of content management solutions have been developed in response to these challenges based on, not only different technologies, but also different approaches. However, none of these present a solution that is both sufficient and consistent. Here we present an analysis of requirements leading to a general model of the information concepts focusing on content management. This model is the basis for a basic content management solution.

**Keywords:** Content mapping, management

### 1.Introduction:

With new technologies emerging each day there is constant need to improve and develop technologies and platforms used everyday. New requirements are developing for creation, publication and management of content. Websites and applications have dramatically grown not only in number, but also in complexity. Hence the job of managing a site can no longer be managed by a single person. We need a team of content providers, editors and designers that strive to deliver up-to-date and correct information. To manage and organize the work of such teams, many website owners have established complex workflow and revision processes to ensure quality of content at all times.

For facilitation and supporting the creation of these managed websites, a huge number of software solutions have been developed. The concepts and approaches underlying these systems are as numerous as the challenges of today's web publishing. Due to most of these solutions being developed incrementally in response to market demand in a continuously evolving industry, they tend to have an absence of a clear and consistent concept; instead offering a mix of various concepts, each more suited for a particular and specific problem. This is where Content Management comes into picture.

Content Management Systems, CMS (are also known as ECMS (Enterprise Content Management Systems), (James Robertson, 2002), are an emerging class of software systems that promotes the management of structured and unstructured business data and content of organizations, such as records of customers or links, as well as documents, text, images or videos. CMS provides great advantages, such as extensibility, modularization and platform reuse; content and presentation independence; easy management and publication of contents; integrated support of multi-language contents; integrated support of users and access control management.

### 2. Requirements:

Maintaining websites presents a whole new set of challenges and requirements. Creation and maintenance of complex sites is a collaborative effort of a team of professionals with different technical backgrounds, these requirements involve content organization and storage, along with support for collaborative working and business workflows. Here, in this segment, we have

described the most important requirements that a content management system must address. Since these requirements are dependent on different types of user roles (content editor, web designer, web site manager etc.), we have grouped them accordingly.

**Content Editor:** Their task is to create and maintain content. They neither decide how their given content will be presented nor do they design how it is accessed or navigated. This separation of tasks leads to a set of basic requirements every content management system should meet. The first of these requirements is the well-known separation of content and presentation. By separating these two concepts, a content management system is able to support a number of content authors while ensuring that all content follows the defined presentation guidelines, such as corporate design or corporate identity. When we take a glance at the content itself, the need for multi-format content is apparent. Many modern websites are available in different languages as internet is a vast global platform. Most of these sites are already capable of adapting to the language preferred by the requesting user. Language however is only one dimension where multi-format content is useful. With an ever-increasing set of web browser technologies and support for a wide range of platforms like mobiles, media phones and PDAs, the content has got to adapt itself to a various number of characteristics. Among these are file format, resolution and size of images or version and level of detail for text. A CMS should not be limited to fixed dimensions, as is often done for language, but rather support a user-definable and extensible property model that then can be used to deliver the best possible content to the client requesting it. One more important requirement is the concept of users, user roles and related permissions. When an imaginably great number of authors are working on the same website, it is essential to keep a track of the sources of all the changes and to control if they should be permitted to perform them. Therefore, along with the versioning, a content management system must also offer the opportunity to create and authenticate users. For the management and classification of such users into hierarchical groups, the notion of user roles, like content editor or content revisor should be available in the system. But users and user groups themselves are not sufficient. Customisable and extensible permissions and user rights must also be

managed and enforced by the system at all times. A joint model of users, groups and permissions that allows the initiator of a website to implement the required user scheme is therefore clearly required.

**Web Designer.** The evolution of the web into a platform for publishing wherein global groups and large-scale companies present themselves leads to various obstacles regarding the designs of said web pages. Companies have protracted their corporate identities and design guidelines to facilitate their website. Graphical designers and artists are employed to develop the look of the individual pages. Surely, a content management system must be knowledgeable about this occurrence and present methods to solve the rising grievance. Again, the previously presented separation of content and presentation emerges as a central requirement to enable such a mode of website development. As a matter of fact, the presentation and design of a website is dependent on the client requesting the page. Modern day's web clients differ greatly with regards to their capabilities. Desktop browsers capable of displaying HTML are certainly the most commonly used clients. But other browsers such as mobiles, media phones, PDAs and voice-based systems have entered the market. Not only do these devices have inadequate support for HTML, but also they have varieties in terms of their display size, colour depth and rendering facilities. Hence, even if a client like this supports HTML, it will obviously need a version other than a desktop browser to provide the different screen dimensions. The possibility of defining multiple designs that are unhinged from given content is the next requirement that a content management system must cater to. To support multi-channel presentation, these design templates must be able to characterise in the same way as the content. By allowing such presentation properties on high granularity levels, it helps the designer to create a presentation for a specific device and the content management to select the most appropriate design for any request. Hence, it is another central requirement for such systems.

**Web Officer:** There are other key dimensions in designing a CMS that tend to be forgotten alongside the omnipresent requirement of separating content and presentation. These further requirements that pass the simple separation of content and presentation are introduced by the line of action of the web officer. Web officers have only recently come into existence because

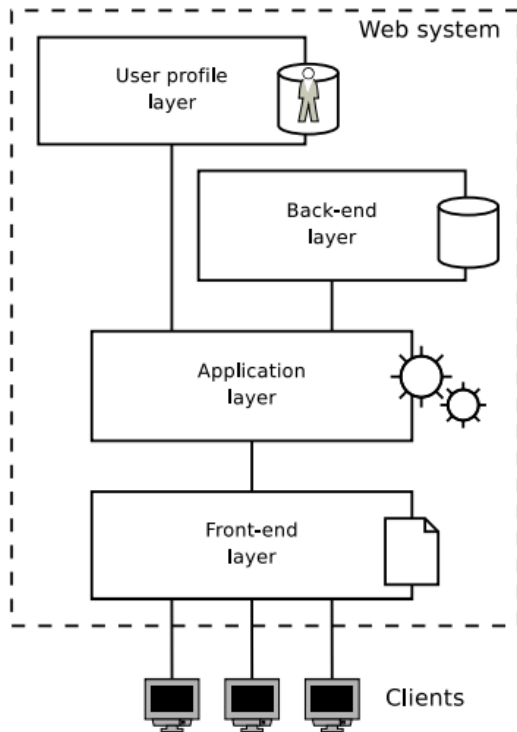
of the emerging large-scale corporate websites. Their job involves determining and looking after the overall structure of a website, designing its navigation and deciding upon personalization options. For designing the navigation and content structure of a web page separately from the content and its presentation, it is mandatory to not only be able to tell the difference between these two approaches, but also administer a clear variety of content, presentation and structure. This requirement is particularly needed when creating websites for multiple presentation channels. If the structure will be mixed up along with the content or the presentation it will need to be recreated or duplicated for each of the presentation channels. Obviously, separating structure does not intend that it cannot differ across such channels if need be. Designing and creating a personalisation scheme for a website is a further task of a web officer. Specifying and implementing such personalisation schemes is thus another characteristic required from a content management system. Such schemes determine which parts of a site could be personalised and what are the options available. For example, it could happen that a user of a website can create their version of certain content. A more restricting option would be that this user was only able to annotate or comment the content of the website. We will call this user centric personalization- explicit personalization, because here the user decides how the website will behave. Implicit personalization is another type of personalisation. Here the client's context will impact how the content management system delivers the pages to the user. Context-awareness is a hence an important requirement for a content management system as the context can be used throughout the entire system to better the personalised and correct delivery of the content. Context is the opposite of characterisation of the content and presentation and is thus enforced by the system to choose the suitable data and templates to develop the page. Context can hence, be defined as a set of (name, value) tuples that describe the user, software, hardware and environment of the client browser. To be context-aware, a content management system must allow the specification of valid context dimensions (e.g. browser-version, screen-size, userlocation, etc.) and use the collected values for building a page.

**Website Manager:** In all the major companies there are a set of business procedures and predefined workflow that define how a content object must evolve until such a time as it is published on the corporate website. By using such procedures, a manager can make sure that no wrong or out-of-date content is shown on any page. Since all personnel supervised by the website manager are working on the website via the content management system, these workflows have to be integrated and enforced by the system. A simple example for a publishing workflow would be the following. (An author initially creates the content object. While editing this object, it is in the state of test. In this state it cannot be accessed or viewed by anyone else. As soon as the editing is done, to publish the object it changes state to Approval. The object will be examined by the supervisor of the object and will either go to the state of Approved or Rejected. If the object is approved, it will be visible for everybody and go live on the website. If it is rejected, the author is informed. He may revise the object and resubmit it for approval. This is a simple workflow consisting of just four states. However a content management system should be capable to support arbitrary processes as these tend to vary between companies. Of course it must also keep track of changes using versioning or related concepts. This system should also be able to notify the corresponding persons whenever any of the state transitions occur.

**Web Engineer:** These are the last persons involved in creating the website. A great number of websites today are not just providing information to their viewers, but are also highly interactive making them a sort of an applicationsuch as e-learning or e-banking platforms. These interactive elements of the website are the courtesy of the web engineers. They use programming to achieve the implementation of particular application logic. A content management system must provide the web engineers with a coherent and open application development platform, that provides basic functionality such as user tracking and shopping carts as optional software modules. A system meeting these requirements prevents engineers from repeating the same implementations for every solution they build and introduces good software design principles into the websire programming.

### 3.Logical Layers of a Web System:

Most web systems is based on a multi-tier logical architecture, that separates the HTTP interface, the application (or business) logic, the data repository and, when existing, the user-related information for authentication and content personalization. They are referred as front-end, application, back-end, and user profile layers Figure shows the structure of a typical system providing Web-based services.



**Fig.1** Logical Layers of a Web System

The front-end layer is the interface of the Web-based service. It accepts HTTP connection requests from the clients, serves static content from the file system, and represents an interface towards the application logic of the middle layer. The delivery of static content is a straightforward operation. A static Web content is stored in a file system and client requests for this type of content are managed by the HTTP server, which retrieves the resources from the file system and sends them back to the client in HTTP responses.

#### Examples

- **Multimedia content:** Audio and video streams are static content. They are handled by the front-end layer. To allow a smooth consumption of multimedia content by the client, we rely on HTTP streaming, that is to divide the resources into pieces of data that are delivered in sequence to the client. The client can start the playback as soon as the first data piece has arrived, without waiting for the delivery of the whole source.
- **Page fragments:** This is a part of a Web page with a unique theme or functionality .Each fragment is considered as an independent information block. Using fragments in the management of static content aims to improve the re-usability of Web content, because some fragments are common to multiple pages.

When fragment-based management of static content is used, the front-end layer is also responsible for the assembly of fragments to build the Web page prior to its delivery to the user.

The application layer is at the core of a Web-based service: its task is to handle all the business logic and compute the information which is used to build responses with dynamically generated content. Content generation needs interactions with the back-end and user profile layers: hence the application layer must be capable of interfacing the application logic with the data storage of the back-end and must be able to access the user profile when personalized content needs to be generated. Dynamic content is generated on-the-fly as a response to client requests.

Examples of dynamic content generated by the application layer :

- Answers retrieved from an organized source of information, such as the shopping cart page or searches in an e-commerce site.
- Web content generated by user social behavior. For example, the pages of forums or blogs provide an exchange place for messages written by the Web users.

The back-end layer manages the main information repository of a Web-based service. It usually comprises a database server and storage of crucial information as a source for generating dynamic content. Referring to the examples of dynamic content generation from the

application layer, we can identify the following data repositories:

- Consider an e-commerce site, database is used for storing the product lists, accessed for searching in the product catalog. The user interactions are managed using a database for shopping cart status or list of purchases.
- Taking the case of a content management system, the content generation is done dynamically. This helps in accessing the database to retrieve web page templates as well as actual contents when web resources are generated.
- For Websites which are blogs or forums, articles, comments, and posts are generally stored in a database.

The user profile layer stores information contains stored information on the user preferences and context. This information is accessed during the dynamic content generation to provide content which is personalized. The information stored in this profile may be originated from multiple sources like:

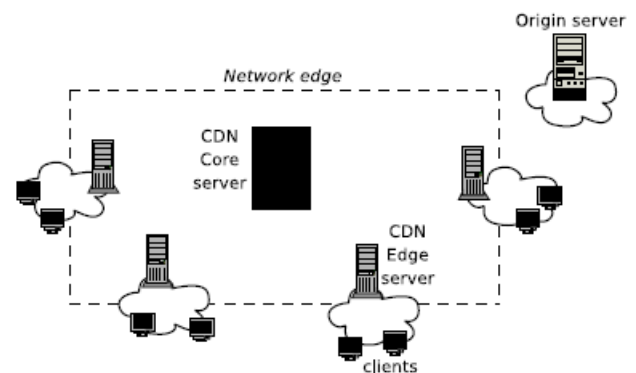
- The information received from users, typically taken from them through fill-in forms to modify their preferences. This profile communication might probably occur when user signs up for access to a web-based service.
- Information brought in from analyzing the behavior of users generally achieved through data mining of web logs. Few typical examples of such web-based services which heavily depend on information obtained through data mining are the recommendation systems for e-commerce or advertisement tailored on user preferences.

#### 4.A Simplified CDN Architecture:

A CDN's architecture aims to achieve high performance and scalability. The principle of replicating the system resources ensures a high level of performance in the service. Replication occurs at local as well as geographic level. In local replication of system resources, the servers that are utilised for servicing user requests are connected. They are situated on the same LAN and typically use a single upstream link connecting the system to the rest of the Internet. This system is known as a *cluster*. Servers inside a cluster provide increased

computing power due to the replication of system resources. They interact in a fast and effective way. The replication might improve fault tolerance as a faulty node is easy to bypass.

The first problem affecting replication on a local scale is the first mile, i.e. the network link connecting the cluster to the Internet. This link represents the system bottleneck for the end-to-end performance; it is a potential single point of failure. Due to Traffic on Web-based cluster zone, failures on an external router, and Denial-of-Service (DoS) attacks the service may become unreachable. For better scalability and performance, it is better to replicate elements of the infrastructure over a geographic scale. A simplified view of a CDN's geographically distributed architecture is shown in Fig. 2.



**Fig. 2** A Simplified CDN Architecture

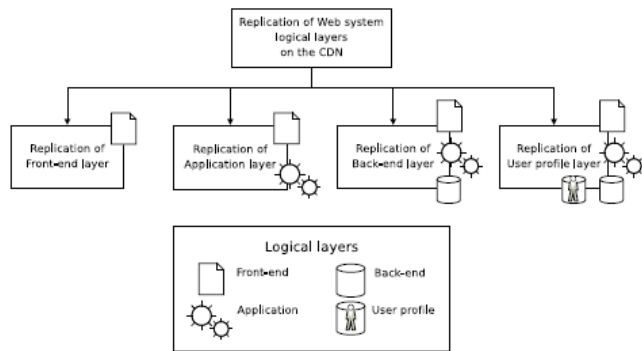
The Core server is a logical entity that handles the functions related to the managing the infrastructure, coordination of request distribution policies, and billing. It can be implemented in two ways. First as a single powerful server. Second as a multi-cluster: a set of clusters cooperating and behaving like a single virtual computer with high availability and computational power.

#### 5. Accelerating Content Generation and Delivery:

The evolving of Web towards ever increasing demand of scalable and high performance content delivery requires the content provider to rely on CDNs. Whereas the CDNs should develop techniques that speed up the delivery of content from the content provider.

For analysing how a CDN accelerates the delivery of Web content and applications, let us take a look at the origin

server and the edge servers, elements of the Web infrastructure most involved in the content delivery process. The directions to address scalability and performance issues are the classical two: caching and replication. The CDNs replicate some logical layers of the origin server on the edge servers. Since we have four logical levels in the Web system, we envision four mapping approaches, as illustrated in Fig. 3.



**Fig 3.** Possible mapping of Web system logical layers on a CDN infrastructure.

- **Replication of front-end layer.** The edge server is responsible only for managing the static content. This is an approach of the first generation of CDNs, where the edge servers, behave like reverse proxies to accelerate the delivery of content that can be stored at the file system level. The replicated Web content may be whole Web objects.
- **Replication of application layer.** A CDN is used to accelerate the delivery performance of dynamically generated content. This approach is called *edge computing*. It shifts the Web application programs on the edge server aiming to generate dynamic Web content close to the clients.
- **Replication of back-end layer.** The edge server provides functions for generating dynamic content as well as hosting data required in the content generation. The origin server is only responsible for the managing the infrastructure and acts as a master copy of the data.
- **Replication of user profile layer.** The edge server also hosts the data repository used for the generation of personalized content.

## 6. Case Study – Content Management Systems Available:

The parameter of functionality depends on customer's requirements. In most of the situations, there is the general option of using template sites and if required, we can connect more modules to the current management system.

To make a decision on which content management system to use for a particular resource, all the available systems in the market must be thoroughly analysed.

- For creating websites, the most acknowledged and used free service these days is WordPress. In the Content Management industry there is great demand for creating blogs. A resource can be created on a certain content management system without needing any special information and making sure that the interface is innate and connects well with the user. Examples of these sites are BBC AMAEICA; Lviv online.
- Another free content management system amongst the masses is Joomla. Its most common use is in building and developing simple corporate sites. Its provides great management along with being high levels of reliability. Examples of this are: IKEA; LINUX.
- A slightly more complex system is Drupal. It is more focused on programming. Sites created using Drupal are more complicated and have designs which are capable of editing. Drupal is coded in PHP. This reason is why people not having prior knowledge of the language and database SQL, are not fit to configure this as a resource for normal work. Examples of these sites are: the official website of the White House; Oreanda.

Taking into consideration all the above mentioned content management systems we can come to the conclusion that the simplest and most user friendly CMS for Development is WordPress. It is highly recommended for people who want no complex functionality in their websites. If looking for a slightly more complex level of functionality we can use Joomla along with an array of tools. The most powerful and functional free CMS is definitely Drupal; although it is suggested only to those who have mastered PHP and MySQL.

## 7. Conclusions:

Through this paper we have firstly shown a number of requirements which are a must for any contemporary content management system. The requirements presented here are closely relatable to the number of user roles existing in teams working on creating, designing and keeping websites up-to-date.

Secondly, we have shown that delivery of static and dynamically generated content can be accelerated through a CDN infrastructure. This infrastructure replicates some layers of a web system. We have analyzed the replication of all logical layers in a web system. Our analysis shows that replication of front-end layer is suited when content provider wants to accelerate static content delivery. When a CDN needs to accelerate the delivery of dynamic content, replication of application layer is suited.

Finally, we have given an overview of a few top content management systems – namely, WordPress, Joomla and Drupal. We have concluded the use of each of these services according to the tools provided by each. In creation of a large resource, where we have hundreds of pages and images we may have a problem. But by using content management systems, we can simplify the entire process. If you are looking to manage your own website, not wondering about its size, the content management system is the most suitable option.

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