



Intelligent Content Routing Technology of SinoCDN – *ActiveRoute*TM

June 2001

Introduction

Internet has been widely used and is becoming part of our lives in recent years. At the same time, the requirement and loading for the Internet infrastructure have increased greatly. Data delivering on the network is no longer only text or simple static content. More complex and large-sized content like graphics, audio, video and streaming media are becoming more popular on Internet. These rich content extensively consume the Internet bandwidth, thus reducing the delivery quality of the network. It makes reliability and availability the significant and challenging problems in the modern Internet. Infrastructure providers and network operators may choose to solve this problem by increasing bandwidth or installing more servers. However, this method will burden the network loading because the network and server scalability problem has not been solved.

Traditional content delivery in CDN

A content-oriented approach network called Content Delivery Network (CDN) has been deployed recently to increase the reliability and availability of content. Users are connected to the closest servers or caches for accessing the content, thus reducing the chance of failure and increasing the quality of service. However, most of the recent CDN solutions do not have an intelligent and dynamic content routing functionality to deliver content from the nearest source. Current methods like multicast and splitter model cannot truly achieve this goal.

Multicast can solve the network scalability by sending single copy of content to numerous clients. However, there are several problems in multicast. The network protocol is complex so that no scalable inter-domain multicast routing exists. It is also not a dynamic routing protocol. Different content with the same set of clients will share the same distribution tree. A fixed distribution tree and branching point is established since it does not have the real-time knowledge of delivery nodes when building the tree.





Splitter model can solve the problem of system scalability by putting splitters/proxies at the edge. However, it is a user-oriented instead of a content-oriented model. A splitter/proxy at the edge can only serve a defined set of users. The interaction between server and splitters/proxies are pre-defined during configuration. It makes the delivery path of content is based on a predefined hierarchy without the knowledge of real-time network status. The distribution tree formation is not dynamic and intelligent enough.

In order to increase the network reliability and content availability, an intelligent and dynamic routing technology has been developed by SinoCDN. This technology, called *ActiveRoute™*, can dynamically establish a content delivery and load-balancing tree for enhancing the quality of the network.

Innovative intelligent content routing architecture – ActiveRoute™

SinoCDN's content networking solution is enhanced with the content-oriented application-level routing technology *ActiveRoute™*. This technology carries out intelligent and dynamic content routing to deliver content on a CDN with the best quality for both network operators and users. *ActiveRoute™* enables content to be transmitted from the best server, replica or proxy based on the application layer information of the network. With the knowledge of real time network status and health, a quality-guaranteed distribution path can be established for delivering the content while optimizing the resource usage. End-user is then able to receive the content with minimum delay and high quality.

Benefits and Features

- Forward content across wide area intelligently and aggressively to solve both system and network scalability problem
- Construct dynamic content distribution tree across network nodes in real time
- Minimize the latency of delivery (i.e., reduce the startup delay)
- Minimize the chance that a server node is overloaded
- Provide a certain degree of quality assurance for the delivery content by considering the bandwidth usage
- Work cooperatively with SinoCDN automatic switch over system



How it works?

*ActiveRoute*TM technology runs application-level routing on top of network mesh. It builds receiver and content-rooted shortest spanning trees by considering load balancing, network health, response time and content availability. The detail of the *ActiveRoute*TM technology is described below.

When a user makes a request on a CDN for a particular content, this request will eventually enter a *ActiveRoute*-enabled (ARE) server node (say, ISG) that is nearest or most suitable to him (by either MediaDNS, L4 switch or other redirection method etc.). After receiving the request, this ARE node will first check for the content availability in itself. If this node is already one of the available sources, the user will be served by this ARE node without performing *ActiveRoute*TM to find the nearest source. Otherwise, this ARE node activates the *ActiveRoute*TM agent to search the best distribution path.

Once the ARE node activated the *ActiveRoute*TM agent, it communicates with neighboring ARE nodes to search for the content. These ARE neighbors will continue communicating with the neighbors in upper levels until the requested content is discovered. A “FOUND” message will be replied to the origin ARE node as acknowledgement of content discovery. If more than one reply is received, *ActiveRoute*TM agent selects the best one based on node loading, network latency and bandwidth availability etc. These selection criteria can be configured according to different kind of applications. For example, loading and bandwidth are more important for streaming media; while network latency is more important for video-conferencing. After that, the origin ARE node can obtain the content following the path found by *ActiveRoute*TM.

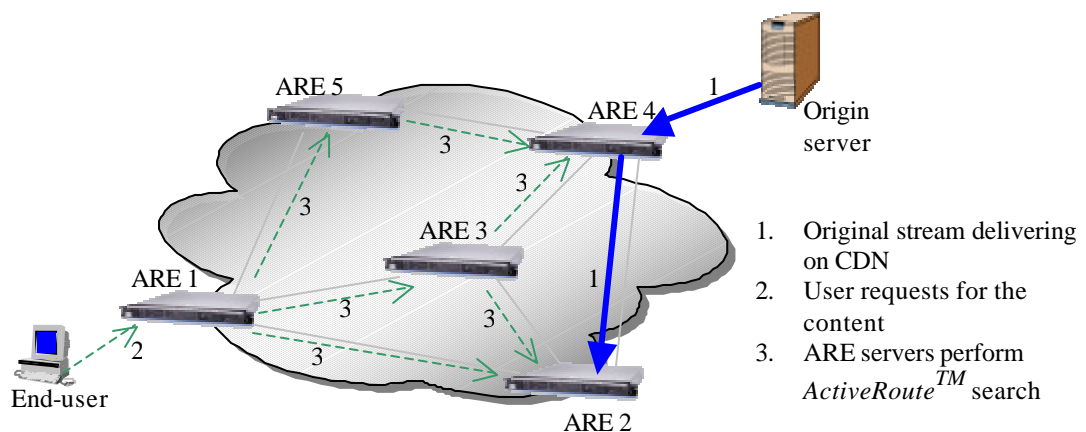


Fig.1(a) *ActiveRoute*TM searching

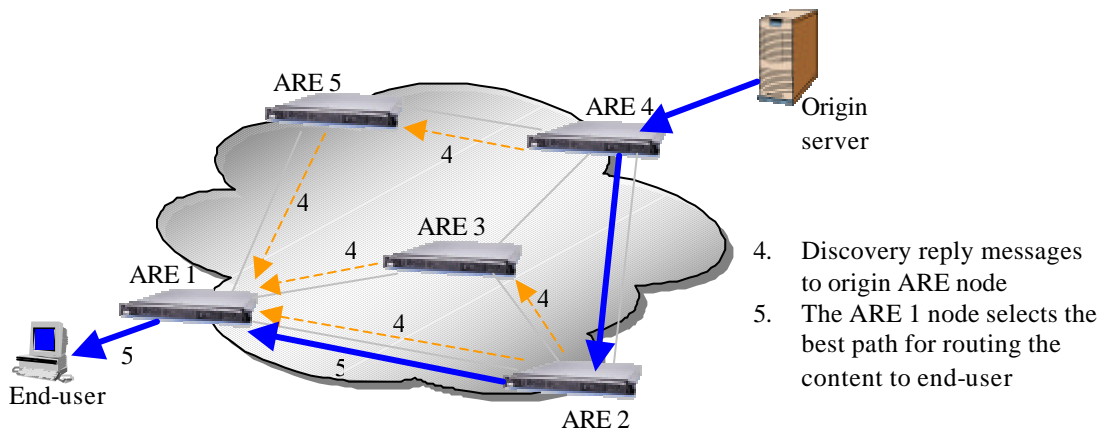


Fig.1(b) *ActiveRoute*TM routing path formation

According to different kind of network topology, the *ActiveRoute*TM search message may be looped in a cyclic network ring. A loop detection and avoidance system has been built in the *ActiveRoute*TM agent to avoid deadlock looping. This makes sure that the process will not be infinitely forwarded in a cyclic ring. Moreover, the routing table in *ActiveRoute*TM is kept updated to allow the ARE node having real time knowledge of the network.

***ActiveRoute*TM API**

An API of *ActiveRoute*TM technology is also available from SinoCDN. This API provides an interface for program developers to develop their own applications that will use *ActiveRoute*TM technology. For example, a caching machine developer can enhance its content routing feature by integrating *ActiveRoute*TM technology into its cache. The architecture of *ActiveRoute*TM API is as follows:

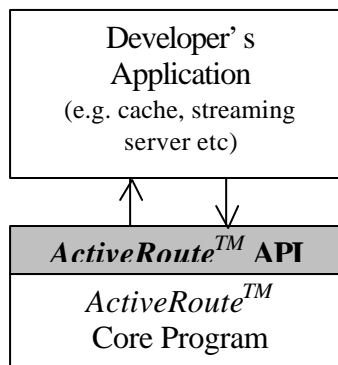


Fig.2 Architecture of *ActiveRoute*TM API



Comparison between hierarchical cache and ActiveRoute™

	<i>Hierarchical cache</i>	<i>ActiveRoute</i>
<i>NPath for dynamic selection</i>	<i>Single Path</i>	<i>Multiple Path</i>
<i>Path Selection Method</i>	<i>Pre-defined</i>	<i>Best path based on Real-time calculation</i>
<i>Selection Policy based on:</i> - Node loading - Latency - Bandwidth availability	No No No	Yes Yes Yes
<i>Single point of failure</i>	<i>Yes</i>	<i>No</i>
<i>Multiple neighbors</i>	<i>No</i>	<i>Yes</i>
<i>Information exchange between machine (Real time knowledge of network and neighbor nodes health status)</i>	<i>No</i>	<i>Yes</i>
<i>Disaster recovery ability</i>	<i>No</i>	<i>Yes</i>
<i>Load-balancing content delivery on different path</i>	<i>No</i>	<i>Yes</i>

Summary

ActiveRoute™ technology provides an intelligent content routing protocol for delivering content from the best server node to end-user. It can minimize the latency of delivery and the chance of overloading. The routing path of content is formed based on application layer information like node loading, network latency, network health and content availability etc. Moreover, an API of *ActiveRoute™* is available for customized and extendable application development. This industry leading technology enables the content routing with intelligence.





About SinoCDN

SinoCDN is the leading broadband infrastructure technology developer in Asia. It offers content networking and management technology, which enables high-quality live and on-demand content delivery over the Internet from long haul to edge networks. Their products are based on their innovative Intelligent Streaming Gateway architecture that can create reliable, intelligent, scalable and easy-to-manage Content Delivery Network infrastructure for millions of users with best viewing experience. The company is headquartered in Hong Kong, with offices in Boston US. Additional information is available at <http://www.sinocdn.com>

