AKAMAI DNSi CACHESERVE

CONTENT-AWARE DNS

IMPROVING CONTENT-AWARE DNS RESOLUTION WITH AKAMAI DNSi CACHESERVE EQUIVALENCE CLASS.

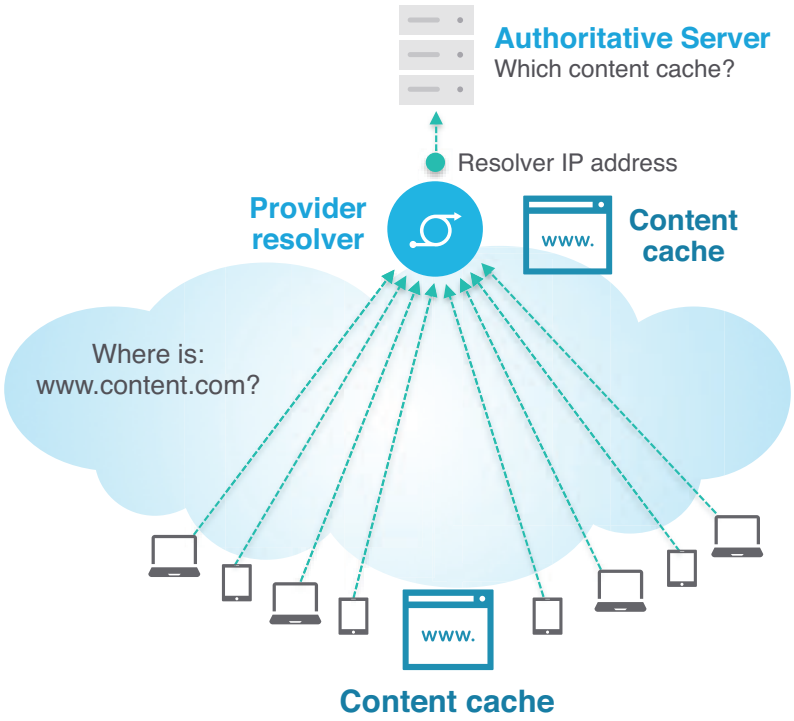
Akamai

CacheServe is the telecommunication industry's gold standard for caching DNS. Its speed, scalability and security are unsurpassed.

Introduction

Internet Service Providers (ISPs) are investigating extension mechanisms for DNS (EDNS0) client subnet (referred to as "ECS" in this paper) to see if it can optimize Quality of Experience (QoE) for their subscribers. In particular, when providers have content delivery network (CDN) caches distributed across their networks, with resolution greater than their resolvers, ECS is being considered as a way to enable selection of content caches closer to subscribers requesting content.

CDN authoritative servers consider geolocation of IPs making content requests (DNS queries) to decide which content cache is best. Without ECS, a CDN authoritative server only has the resolver's IP address to decide which content cache is nearest. In this case, the authority doesn't know that there is a content source closer to subscribers.



This paper will briefly cover the origins of ECS, describe how it works and discuss limitations of the current Internet Engineering Task Force (IETF) draft Request for Comments (RFC). It will then describe an important new capability for ECS called equivalence class, implemented in CacheServe resolvers, which provides more utility in ISP environments, cost savings for the provider and a better subscriber experience.

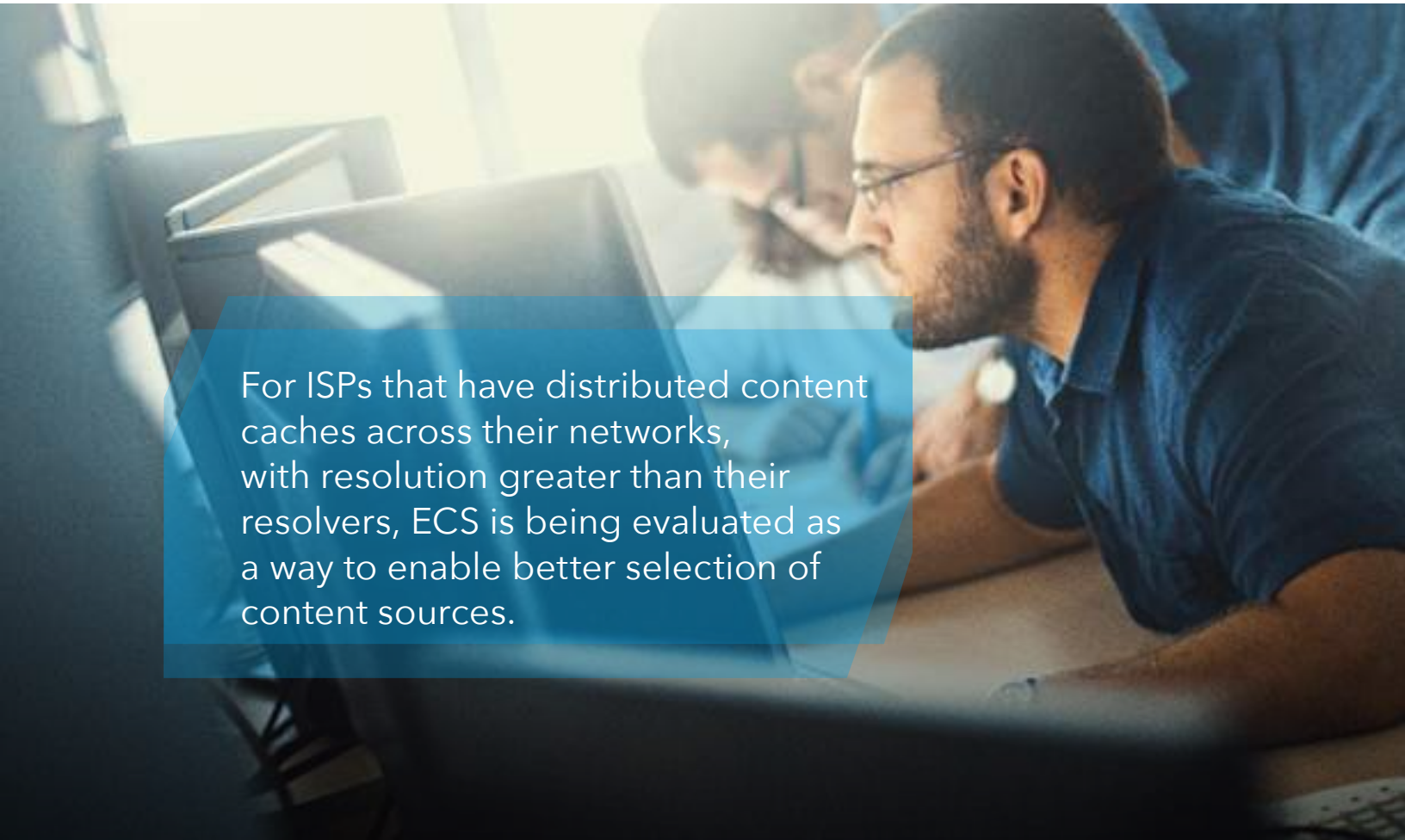
EDNS0 Client Subnet

A draft RFC for ECS was published in 2011 when public DNS resolution services like GoogleDNS and OpenDNS discovered their users were increasingly remote from their resolvers, sometimes many thousands of miles away. In order to offer the best source for content, CDN providers need to know where the actual requestors of content are located, versus where their DNS resolvers are located. Without ECS, CDN authoritative servers rely on a resolvers IP address to suggest the requestor's location. This assumption is reasonable when resolvers are in close proximity to clients, but when resolvers are substantially remote from clients they serve, authoritative servers need a better way to gauge the location of clients.

ECS incorporates the subnet of a client in recursive requests to authoritative servers. Given a client subnet, an authoritative server has better information about where a client is located and can make a more informed decision about the optimal location of a content cache. For providers of public DNS services, where clients may be a continent away from their resolvers, ECS offers better resolution of content sources.

ECS and ISP Networks

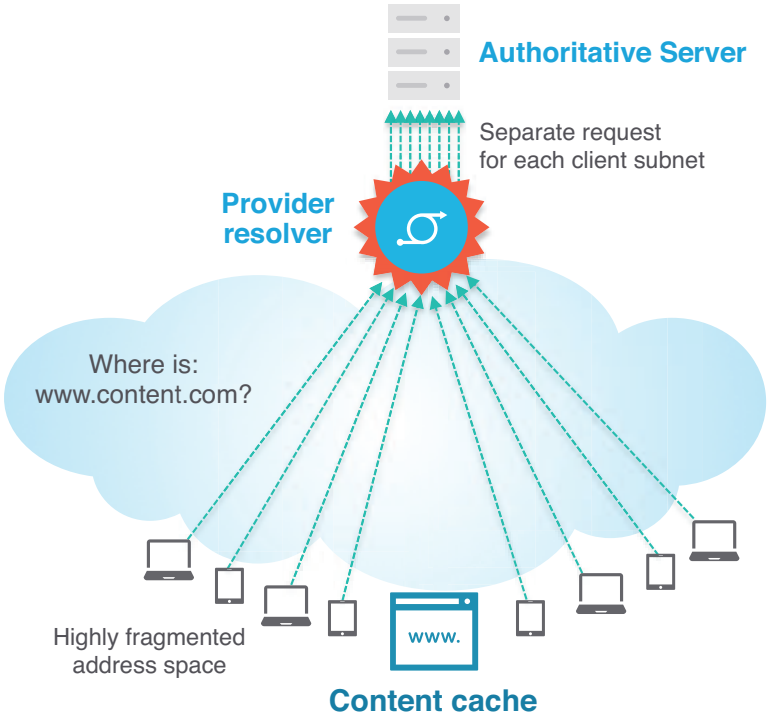
For ISPs that have distributed content caches across their networks, with resolution greater than their resolvers, ECS is being evaluated as a way to enable better selection of content sources. However, providers have been challenged to aggregate their IPv4 address space due to increasingly smaller ad-



"MUST-HAVE" CAPABILITIES TO **DELIVER TOP-TIER CARRIER QUALITY**

dress allocations or other constraints within their networks. This means resolvers serving hundreds of discontiguous subscriber subnets are often encountered.

When ECS is configured for a domain, each client subnet may generate a separate recursive query and cache entry. Cache size and load on the resolver can grow exponentially, which impacts both cost (more memory, more processing power needed) and resolver performance. Time to Live (TTLs) commonly used by CDNs magnify this problem. Worse still, the additional effort to optimize answers may be unnecessary, since authoritative servers may reply with the same answer for different client subnets. Providers with highly fragmented address space often have



AKAMAI, THE TRUSTED LEADER IN DNS RESOLUTION

We are continuously innovating to help you increase operational efficiency and manage costs, while optimizing for quality, reliability, and scale.

resolvers serving hundreds of client subnets. When ECS is configured for a domain, the recursive load and cache size increases substantially because each subnet generates a separate recursive query and cache entry.

To better manage the address fragmentation problem, CacheServe resolvers have a patent-pending capability known as equivalence class. Equivalence class makes ECS scale by allowing any arbitrary group of subnets such as all subscriber subnets behind an edge router (BNG, CMTS, etc.), or all subnets in a city or region, to be configured to use a single "representative" subnet in ECS requests. CacheServe maintains tables that

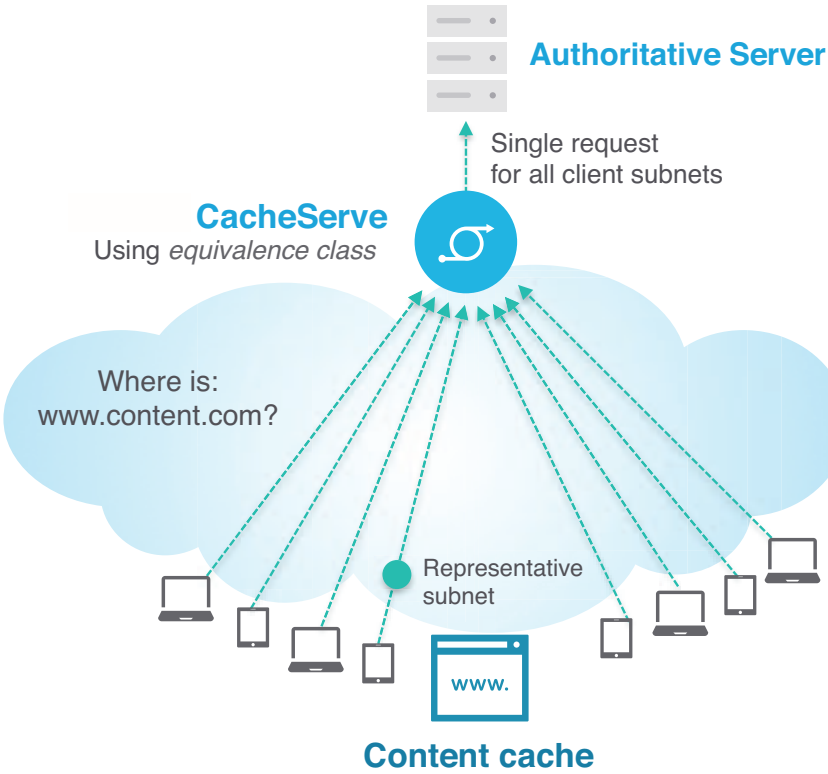
map between each group of configured address blocks and their corresponding representative addresses. For domains configured to use equivalence class, when the IP address of an incoming query matches against a table, the corresponding representative address is used for cache lookups, recursive queries and caching results.

With equivalence class, CacheServe uses a single "representative" subnet instead of numerous client subnets. This substantially reduces load on resolvers and authorities.

With equivalence class, any "representative" subnet can be chosen, but as the name suggests its purpose is to represent the location of an arbitrary group of subscribers to CDN authoritative servers. The subnet representing blocks of subscribers can be configured based on the location of content sources, provider network topology and costs. In cases where subscribers use private IP addresses, a public IP address must be used. By using a representative subnet, equivalence class dramatically reduces recursion traffic and the excessive caching that would otherwise be incurred when using ECS.

Examples

As stated at the beginning of this paper, DNS authorities today depend on resolver addresses to infer a content requestor's location. Conveying a representative location that better reflects where content requestors are actually located helps authorities make better decisions. There are a few ways this capability might be used:



Some Internet access providers have the same problem as public DNS providers: subscribers that are substantially distant from the resolvers they use. ECS and equivalence class offer authorities better guidance.

Provider resolvers are provisioned in data centers and their connectivity may be different than connectivity of the subscribers they serve. Routes to/from a data center for recursion may be less desirable than using routes to/from subscribers to serve content.

An equivalence class representative subnet can be any subnet; it merely offers a "hint" to an authority about location. Rather than represent the location of subscribers, it could represent a network location a provider prefers from a topological perspective, because it provides lower cost or higher bandwidth.

The access provider can guide the CDN provider to offer sources of content at a location that benefits the ISP.

Summary

Providers with distributed CDN caches across their networks, investigating ECS to better align content sources with their subscribers, can take advantage of equivalence class, a new feature in CacheServe resolvers. Equivalence class can dramatically reduce recursion traffic and unnecessary caching by allowing discontiguous address blocks to use a single representative subnet in ECS requests. CacheServe maintains tables that map between each group of configured address blocks, and their corresponding representative addresses. For domains configured to use equivalence class, when the IP address of an incoming query matches against a table, the corresponding representative address is used for cache lookups, recursive queries, and caching results. ISPs using equivalence class can optimize content sources for their subscribers while managing the load on their resolvers.