



Open Connect Overview

What is Netflix Open Connect?

Open Connect is the name of the global network that is responsible for delivering Netflix TV shows and movies to our members world-wide. This type of network is typically referred to as a “Content Delivery Network” or “CDN” because its job is to deliver internet-based content (via HTTP/HTTPS) efficiently by bringing the content that people watch close to where they’re watching it. The Open Connect network shares some characteristics with other CDNs, but also has some important differences.

Netflix began the Open Connect initiative in 2011, as a response to the ever-increasing scale of Netflix streaming. We started the program for two reasons:

- 1) As Netflix grew to be a significant portion of overall traffic on consumer Internet Service Provider (ISP) networks, it became important to be able to work with those ISPs in a direct and collaborative way.
- 2) Creating a content delivery solution customized for Netflix allowed us to design a proactive, directed caching solution that is much more efficient than the standard demand-driven CDN solution, reducing the overall demand on upstream network capacity by several orders of magnitude.

Several years in, we are constantly learning - adjusting and evolving the program to ensure that our members continue to have a consistently high quality video experience from wherever they are in the world.

The overall mission of the program is to enable ISPs to provide a great Netflix experience for our mutual customers. We further this goal by localizing Netflix traffic as close as possible to our members, limiting the network and geographical distances that our video bits must travel during playback. This of course benefits Netflix members, but it also benefits ISPs and internet users in general. In short, we invest in efficiency

innovations and increasing the capacity of the internet to support playback requests for Netflix content - so that others don't have to.

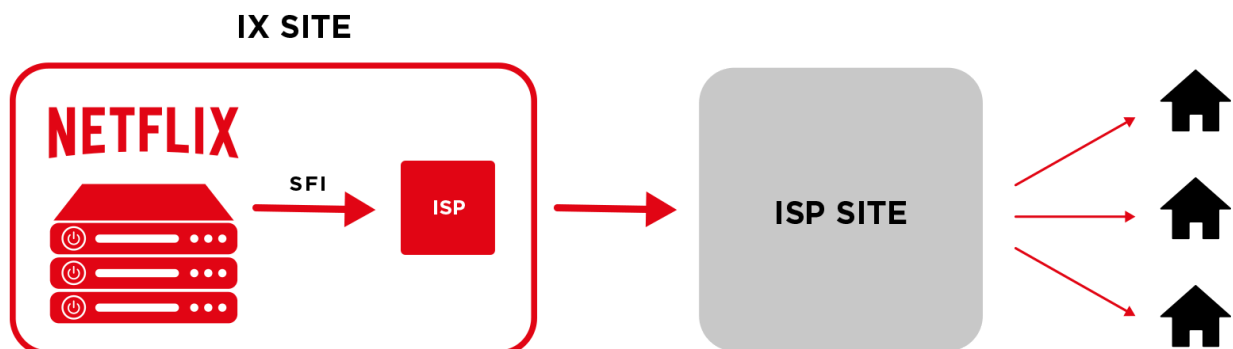
Open Connect Appliances

The building blocks of the Open Connect infrastructure are our suite of purpose-built cache server appliances, called Open Connect Appliances (referred to as 'OCAs', 'appliances', or generally called 'servers'). These appliances temporarily store encoded video/image files and serve these files via HTTP/HTTPS to client devices (for example: set top boxes, mobile devices, or smart TVs) through ISP networks. OCAs have the sole responsibility of storing playable bits to make content available to client devices as efficiently as possible.

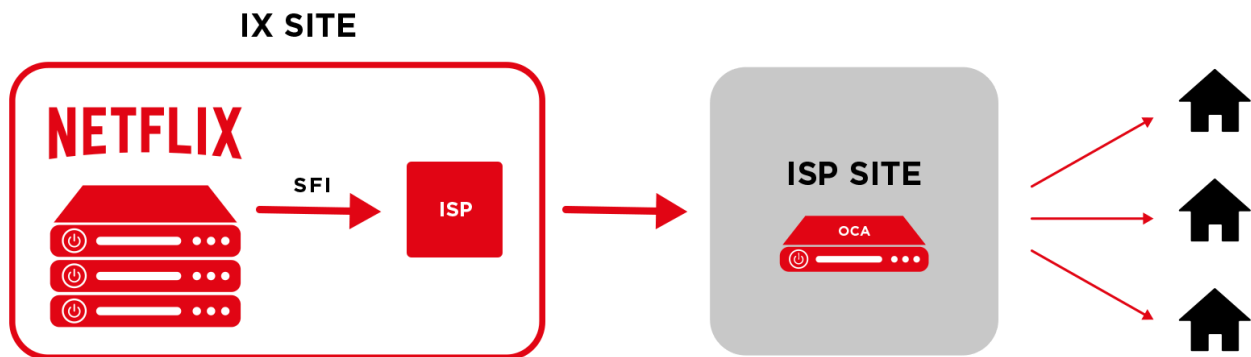
As with all facets of the Open Connect program, appliance design continues to expand and improve over time to keep up with our current and future needs. We are involved in the development of all layers of the software stack, and we make both the hardware design and the software available via open source for others to benefit from.

Our global network of thousands of OCAs are deployed in two ways:

1. We install OCAs within internet exchange points (referred to as IXs or IXPs) in significant Netflix markets throughout the world. These OCAs are interconnected with mutually-present ISPs via settlement-free public or private peering (SFI). Peering alone can be very beneficial to our ISP partners.



2. We provide OCAs free of charge to qualifying ISPs. These OCAs, with the same capabilities as the OCAs that are in the IXPs, are deployed directly inside ISP networks. We provide the server hardware and the ISPs provide power, space, and connectivity. ISPs directly control which of their customers are routed to their embedded OCAs. ISP partners with embedded OCAs also use peering for resiliency and to enable efficient nightly fill and updates, described later.



Each individual OCA deployment site is custom tailored by the Open Connect team based on local network characteristics and other key capacity planning factors. After we deploy OCAs to a site, we constantly measure and analyze their performance and augment capacity as requirements evolve.

Interaction with Client Devices and Netflix AWS Services

OCAs do not store client data (for example - viewing history, DRM info, or member data). Essentially, OCA servers only do the following two things:

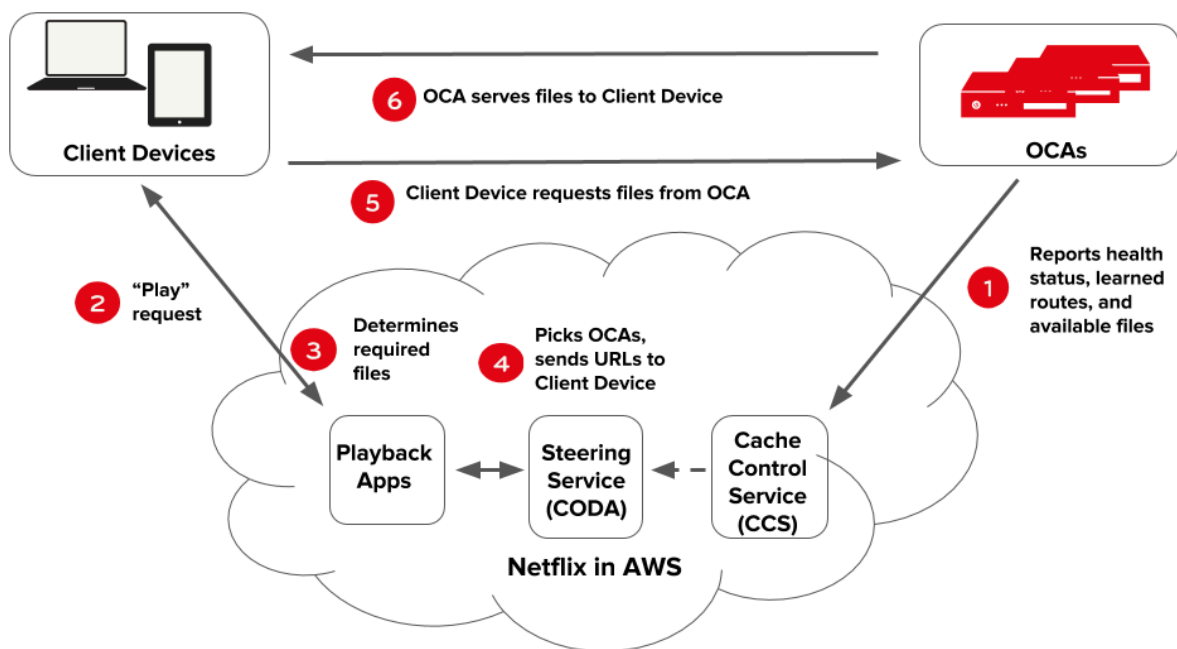
- Report their status to the Open Connect control plane services in Amazon Web Services (AWS). For example, they report health metrics, BGP routes they have learned from the BGP peer (router or switch) they have a configured BGP session with, and what files they have stored on disk.
- Serve content via HTTP/HTTPS when it is requested by a client device.

The control plane services in AWS take the data that the OCAs report and use it to steer clients via URL to the most optimal OCAs given their file availability, health, and network

proximity to the client. The control plane services also control fill behavior (adding new files to OCAs nightly), compute optimal behavior for such things as file storage/hashing, and handle the storage and interpretation of relevant telemetry about the playback experience.

Open Connect also partners extensively with Netflix client teams to ensure that the content that is served by the OCAs is optimized dynamically by each client device based on its specific needs and the current network conditions.

The following diagram illustrates how the playback process works:



1. OCA's periodically report health, routes they have learned, and content (file) availability to the cache control services in AWS.
2. A user on a client device requests playback of a title (TV show or movie) from the Netflix application in AWS.
3. The playback application services in AWS check user authorization and licensing, then determine which specific files are required to handle the playback request - taking individual client characteristics and current network conditions into account.

4. The steering service in AWS uses the information stored by the cache control service to pick OCAs that the requested files should be served from, generates URLs for these OCAs, and hands the URLs over to the playback application services.
5. The playback application services hand over URLs of the appropriate OCAs to the client device, and the OCA begins to serve the requested files.

Monitoring, Maintenance, and Updates

All of our OCA deployments, whether in IXPs or embedded in ISP networks, are constantly monitored by the Open Connect Operations team to ensure reliability and efficiency. We troubleshoot and proactively fix most issues remotely with minimal input required from our ISP partners. If partners wish to monitor their own embedded OCAs' status and performance, we provide a Partner Portal where they can do so. If hardware performance degrades to the point where a server is no longer functioning in the range of our quality standards, we simply replace it - at no cost to our partners.

We have the somewhat unique benefit of being able to deploy the majority of our content and software updates proactively during off-peak fill windows. Because we can predict with high accuracy what our members will watch and what time of day they will watch it, we make use of non-peak bandwidth to download the vast majority of content updates to the OCAs in our network during these configurable time windows. OCAs can also download updates from each other - minimizing significant usage of internet "backbone" capacity during the update cycle.

We use ever-evolving popularity algorithms and storage techniques in the control plane services to ensure that our content is distributed in ways that maximize offload efficiency and quality of experience, while minimizing churn in the form of updates to the content that is stored on the appliances.

More Information

For more information about Open Connect, see:

- [The Open Connect website](#)
- [Open Connect articles on the Netflix Tech Blog](#)
- [Open Connect articles on the Netflix Media Center](#)

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