



## Hive Streaming Technical Brief

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## Technology

Hive Streaming solves the issues with large scale, high quality video streaming in private networks. Hive utilizes idle infrastructure capacity for efficient and scalable video streaming. Hive is network friendly and is by default set-up to always yield to other network traffic. Hive is simple (software only) and fast (hours) to deploy and requires no or little on-going support and maintenance.

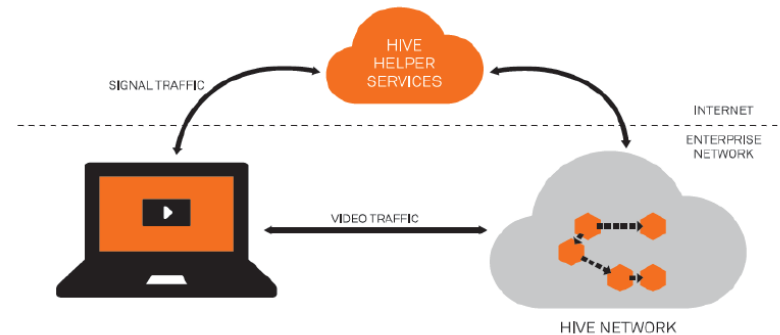
All this is done by allowing existing devices such as computers, laptops and mobile devices to form a peer-based video distribution network (VDN). A Hive VDN consists of viewer devices cooperating to cache and distribute chunks of video coordinated by the Hive algorithms. The Hive Clients jointly and autonomously select the optimal way to fetch the right content at the right time and automatically distributes it amongst themselves.

The result is a highly resource efficient, robust and adaptive system that removes almost all network load whilst maintaining very high levels of reliability. Even when key Clients in the network suddenly disappear (e.g. a viewer shuts down the computer), other Hive Clients

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will seamlessly take over their responsibility without any disturbance to the viewers.

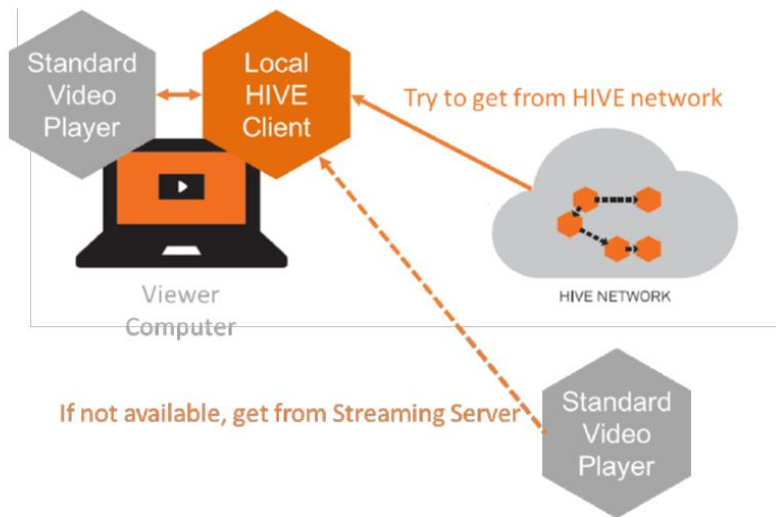
The Hive Streaming technology – some of it described here – is based on several patent pending distribution algorithms enabling enterprises and other private network operators to remove 97-99% of the video traffic fully replacing hardware based multi-casting solutions.



*Hive Components*



## The Hive Client



*HIVE Client Operating Model*

At the core of the Hive solution is the Hive Client. The Hive Client runs on each viewer's device and is responsible for getting video streams from the best available source. Usually the best source is another Hive Client that has fetched and cached the required video data chunks just milliseconds before. Only if no other Hive Client has that particular chunk of video data does the Hive Client obtain the data from a streaming server or from an external CDN.

Hive Clients act as transparent HTTP proxies between video streaming servers and players. Technically this is achieved by pointing the video player to the local host address and supplying the manifest URL as a parameter.

The Client is designed to use little local resources – both in terms of CPU, memory, disk and network capacity. It constantly monitors its usage of local resource and adapts its behavior to ensure that the end user never notices the background activities done the Hive client. Typical resource usage is 1-3% of CPU whilst streaming



and 45 MB (idle) respectively 128 MB (streaming) of RAM.

Hive Clients use HTTP and HTTPS to communicate with streaming servers and the Hive Helper Services. A proprietary UDP protocol is used for communication between Hive Clients. By default, all client-to-client communication is encrypted.

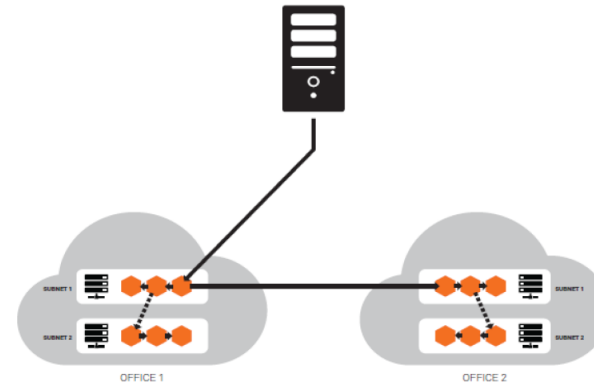
### The Hive Helper Services

The Hive Helper Services are cloud based services helping Hive Clients to locate each other and to establish network connections between Clients. It is also used to gather and display statistics before (using the Hive “silent” mode streaming), during and after events. No video traffic is sent to the Helper Services, all video traffic occurs between Clients in the local network.

To deliver on the guarantee of one incoming stream per network segment, Hive uses a number of networking strategies and prioritizes network routes in the following order:

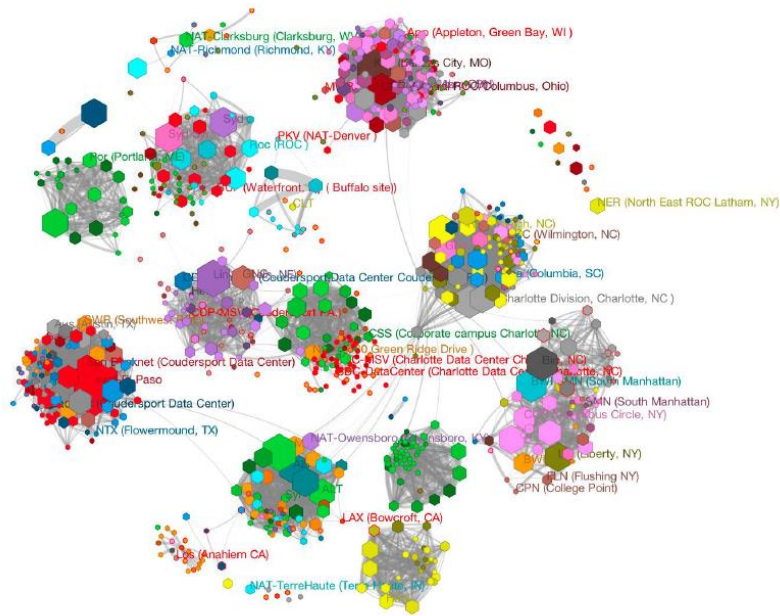


- Same Subnet / Broadcast Range
- Same Internal AS/Site (optional)
- Behind the same Public IP range
- Internet AS



*Hive guarantees that only one stream reaches each network segment.*

In addition to those static priorities, Hive uses dynamic route prioritization based on throughput as measured by Client-to-Client during a broadcast. This enables Hive to quickly and efficiently find the optimal paths through big networks and respond to sudden network changes if a network link fails or gets congested.



*Traffic kept local within sites during a 3,000 viewer Town Hall event*

## NAT Firewall Handling

Hive Clients use a number of advanced techniques to safely traverse NATs and firewalls. This is achieved automatically and **no configuration is needed**. If strict UDP blocking firewalls are deployed either on viewer devices or within parts of the network, white listing Hive traffic may increase the Hive VDN efficiency.

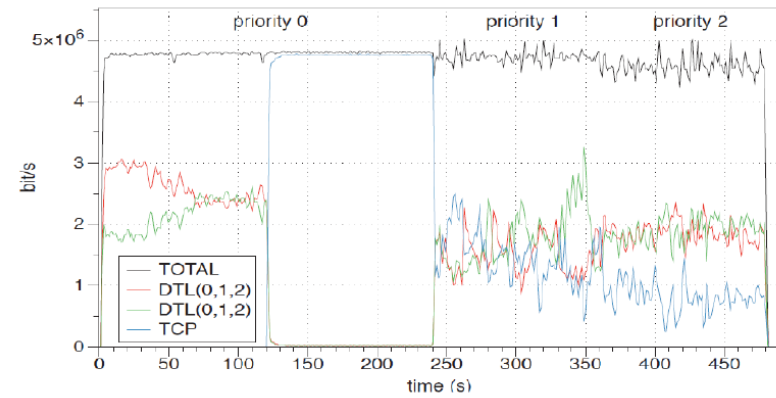
## Traffic Priorities

Hive has a built in advanced congestion control which can be configured according to different business needs: By default, a deployed Hive VDN is set to operate in LOW priority mode where Hive traffic yields to all other network traffic and thus *only* uses idle network resources. If required, Hive can be configured to use NORMAL or HIGH priority.

Priority	Behavior	Recommendation
Low (0)	Yields to other traffic types	Default mode. Most networks have enough spare capacity to enable



		high quality HIVE video with LOW priority.
Normal (1)	Shares bandwidth with TCP	Use if network is busy and the TCP traffic is not business critical.
High (2)	Forces TCP to back off. Uses up to 67% of available capacity.	Use if TCP traffic has low business value.



*Hive congestion control in action: Red and Green are Hive streams, and Blue is TCP traffic. Notice how the Hive streams immediately yield when the TCP traffic starts at 120 s.*



## Getting Started

To start using the Hive VDN, customers must set-up a Hive Services account and deploy Hive Clients on end user devices:

- **Activate a Hive Services account and login to the Customer Portal.** A Hive Services account is created and log-in credentials are provided upon signing a Hive Services contract.
- **Deploy the Hive Client.** A customer specific set of Hive Client installer packages are provided through the Customer Portal. Installer packages can be downloaded from the Portal and deployed using an enterprise software deployment system. Hive Clients can also be downloaded and installed manually by end users via a web page.
- **Modify the manifest URLs used by video players.** The standard manifest URL is prepended with a Hive prefix: If the ordinary manifest URL is [<https://stream.mycomp.com/live.isml>] then the Hive enabled URL will look similar to [<http://127.0.0.1:8999/smoothstream/?callback=customer-callbacks.appspot.com/89/34fa84238df2587aa75ac7e90ccf92?ref=https://stream.mycomp.com/live.isml>]

## Installers

From the Customer Portal, the following installer packages can be downloaded:

- Windows XP, Vista, 7 and 8. MSI and EXE versions available
- Mac OS 10.7 and later (in .DMG format)
- Linux (custom installers available on demand)
- **Add the Hive Client check Java script** (optional). A Java script checking if the Hive Client is installed can be added to the player webpage. The script will check if the Hive client is installed, and if not, prompt the users to download the Client.
- **Add buffering statistics to video player** (optional). Modifying the video player to collect buffering statistics enables the Hive Client to gather viewer experience data directly from the video player and to display aggregated information in the Hive Services standard statistical interface. Reference implementations and code examples are available in the Customer Portal.
- **Integrate Hive statistics into third party video portal (optional).** Using a simple API, Hive



Services statistics can be integrated in existing customer reporting tools.

## Mobile Device Support

Hive supports the following mobile platforms:

- IOS (iPhone and iPad version 4 or later)
- Android (version 3 and later)
- Windows Phone (version 8 and later)
- Windows RT

Hive Clients for mobile devices will only download video. Mobile Clients are restricted from uploading video to the Hive VDN in order to conserve device battery power and radio network capacity. The mobile Clients can be provided as white labeled native applications where branding and integration is needed.

## Security

Hive has been built with security in mind from the start: All Hive Client-to-Client traffic is encrypted with SSL and Clients authenticate each other before any communication starts. All traffic to the Helper Services is anonymized and customer data is stored in a secure manner. Secure connections are used for auto-updating the Client or sending sensitive information.



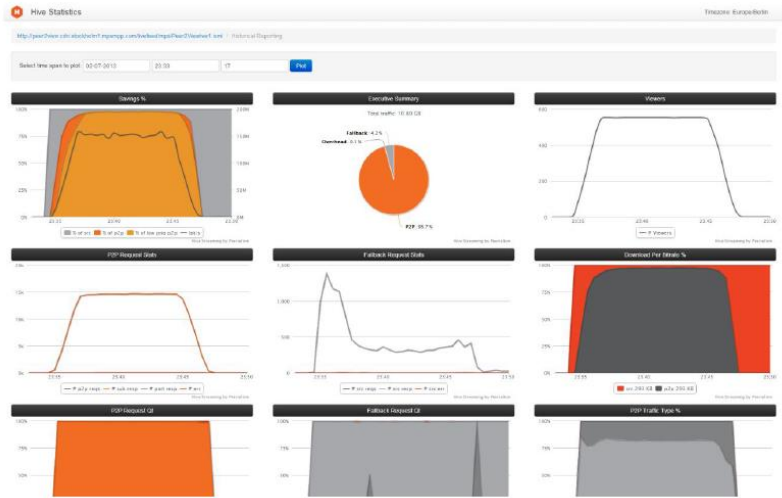
To secure the video, Hive transparently supports most DRM solutions. Customer video data is only distributed locally amongst Clients. No video data is sent to the Helper Services.

Operating Hive

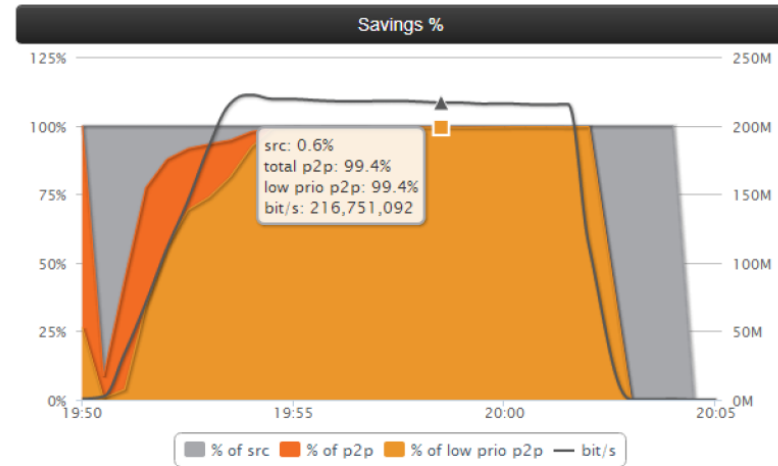
Customer Portal

Hive offers detailed monitoring during and after events. Through a web-based dashboard, customers can follow the event in real-time and analyze historical post-event data. Historical data can be exported to standard formats for further analysis in external tools. Hive monitors number of viewers, load on servers, network conditions and viewer experience. Hive can also monitor the streaming behavior on individual devices if needed for advanced troubleshooting.





*Hive Graphs showing performance, viewers, QoE and network statistics after an event*



*Graph Portlet example which easily can be integrated into external system*

## Preparing Events

Hive has the option of "silent" streaming: Video can be streamed through the whole chain of distribution all the way to the video player before a specific event, or on a regular basis. This allows for simple but comprehensive testing of interoperability, new functions and network



capacity. Silent streaming in the Hive VDN is run as a low priority background service without disturbing end users.

#### Client Monitoring

The Customer Portal shows the number of Hive Clients currently online (“Online Clients”) and the number of unique Hive Clients that have been online at least once last month (“Installed Clients”).

#### **About Hive Streaming**

Hive Streaming is developed by Peerialism Technologies in Stockholm, Sweden and is a result of several years of research and development efforts spanning multiple technology areas with the objective of creating the most efficient video distribution solution.

Hive Streaming is used by enterprises and private network operators seeking to maximize the business value of video streaming whilst keeping the network impact at a bare minimum.



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