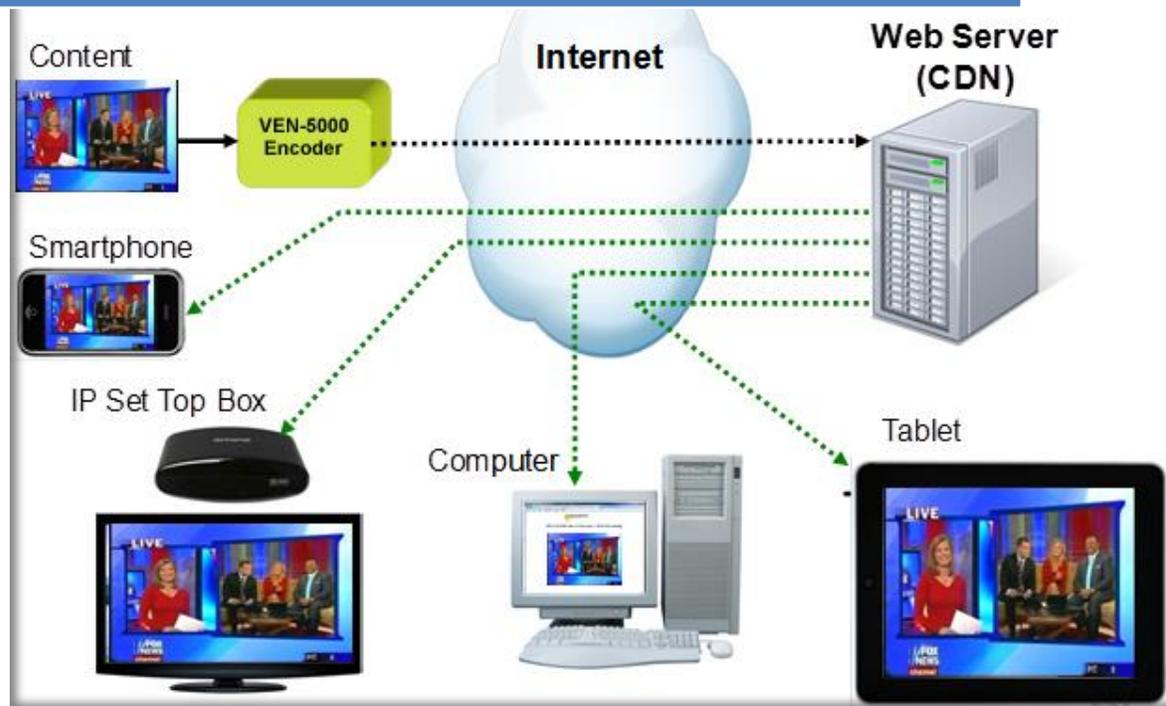


An Introductory Guide to IPTV: Enterprise Multi-cast, Scalable Internet Video Streaming and Web-based Monitoring



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Scalable Video Streaming over the Internet

Introduction

For many applications, it is very desirable to deliver video content, either stored or live, through the Internet. Internet bandwidth available to end users has steadily increased over the last few years, and many enjoy connections that are capable of support even High Definition services.

However, the traditional IPTV delivery protocols are not suitable for the Internet:

- The one-to-many delivery solution for traditional IPTV is based on IP Multicast. While this is the right technology for a closed managed network, it is not supported by the Internet.
- Traditional IPTV delivery assumes that the network infrastructure absolutely guarantees the bandwidth to all end users:
 - Only one bit rate for each stream is available, and all users are assumed to be able to receive it. If there are different access levels in the IPTV network, operators normally set their bit rate (quality) based on the lowest access level.
 - Protocols do not handle packet losses well (in most cases, there are no mechanisms to handle this, since the network infrastructure is expected to deliver all packets without any drops).

These assumptions are not true for the Internet.

- Traditional IPTV protocols are not very suitable for traversing firewalls (although proprietary solutions exist). In the Internet, virtually all users today are behind some sort of home gateway/firewall.

The Internet today is geared to delivering Web content. The problem of scaling a web server to millions of users is well understood, the TCP protocol used on the HTTP connections is capable of dealing with lost packets, and every firewall out there can handle access to a web site. Therefore, an ideal video delivery solution should be based on Web/HTTP technologies. It should also automatically adapt to each user's individual Internet bandwidth, so that every user can have the best viewing experience afforded by their connection.

Adaptive Streaming Protocols

The primary objective of Adaptive Streaming is to provide the user the best possible viewing experience given his/her instantaneous available Internet connection capacity. The key ideas are as follows:

- Make available to the playback device multiple versions of the same content at different bit rates. Obviously, the higher the bit rate, the better the quality of the content. The lower bit rate versions can be at reduced resolution.
- Let the playback device decide what version of the content to use based on its detected network conditions (rather than trying to manage this at the server side).
- Organize the content in such a way that the playback device can switch from one quality level to another on-the-fly, in a seamless fashion, again without involving the server.

This idea, combined with HTTP-based delivery, provides an excellent mechanism for delivery of content over the Internet. The server provides multiple copies of the same content at different bit rates; the playback device chooses one to start, and monitors the network performance. If the playback device detects that it is falling behind, it switches to a lower bit rate stream; if it detects that it is downloading faster than real-time, it switches to a higher bit rate stream. The content has well-defined (and signaled) transition points where this switch can happen in a seamless fashion. Since this process is managed at the playback device (without the need for upstream communication with the server), this architecture is very scalable, and can be implemented with unmodified traditional web servers.

Currently, the two main Adaptive Streaming protocols available are:

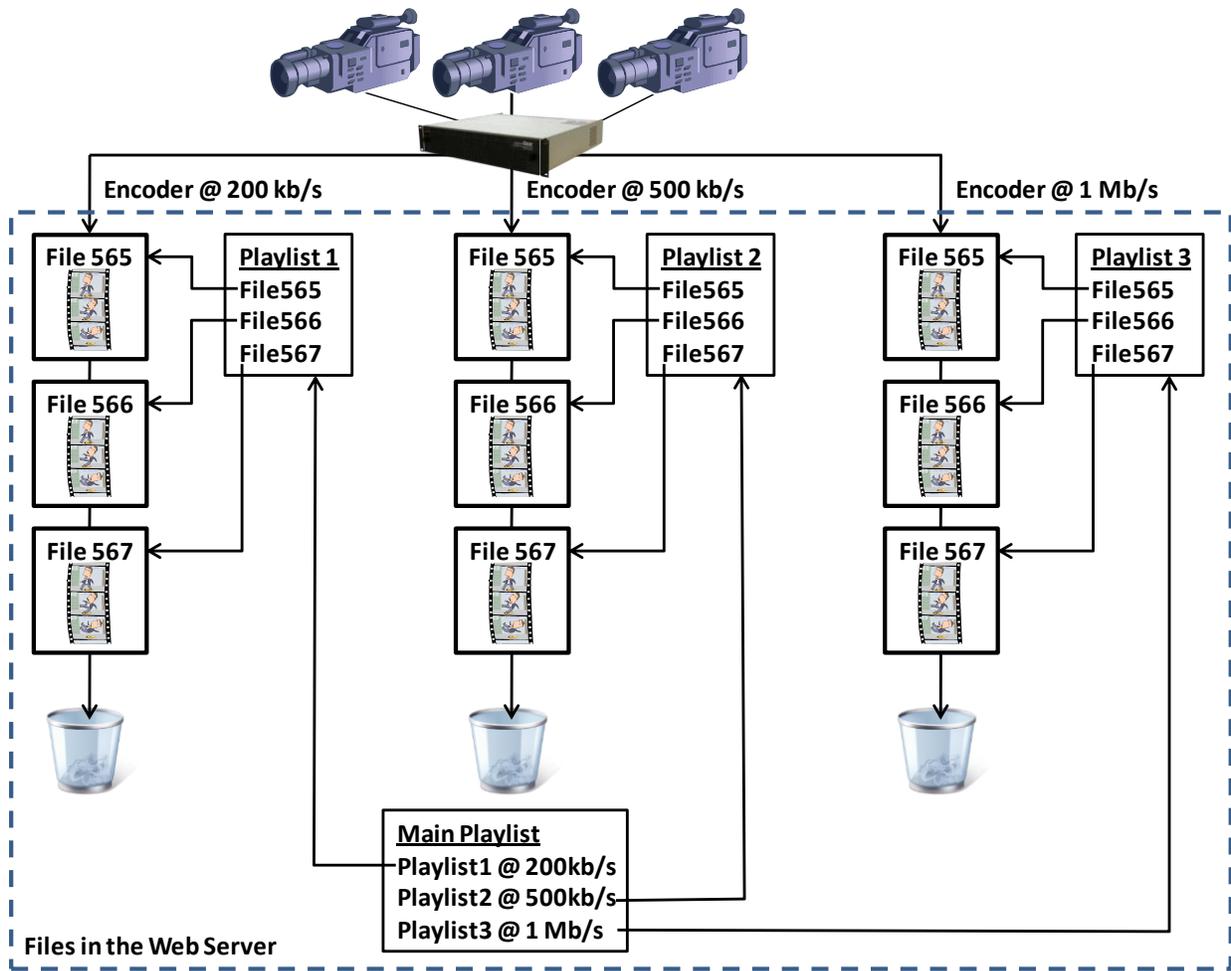
- Microsoft Silverlight.
- HTTP Live Streaming (HLS), proposed by Apple. The protocol is documented as an Internet Draft in [draft-pantos-http-live-streaming](#).

Fundamentally, both protocols work the same. As an illustration, we summarize here the HTTP Live Streaming operation.

The basic idea of the protocol is to divide the live stream into file segments, which are placed in a web server. As the encoder produces bitstream, new files are created (and optionally the older files are deleted). A playlist file is also placed in the server, pointing at the segments. As new segments are added (and old ones removed), the playlist file is recreated. Clients obtain the playlist file and refresh it as required, as they play the segments.

The same content may be offered at multiple bit rates. It is up to the client to decide what bit rate it can accept, based on the current conditions of its Internet access. Multiple bit rates are offered through a playlist, which point to the dynamic playlists for each bit rate. As long as the set of bit rates does not change, this top playlist can remain static.

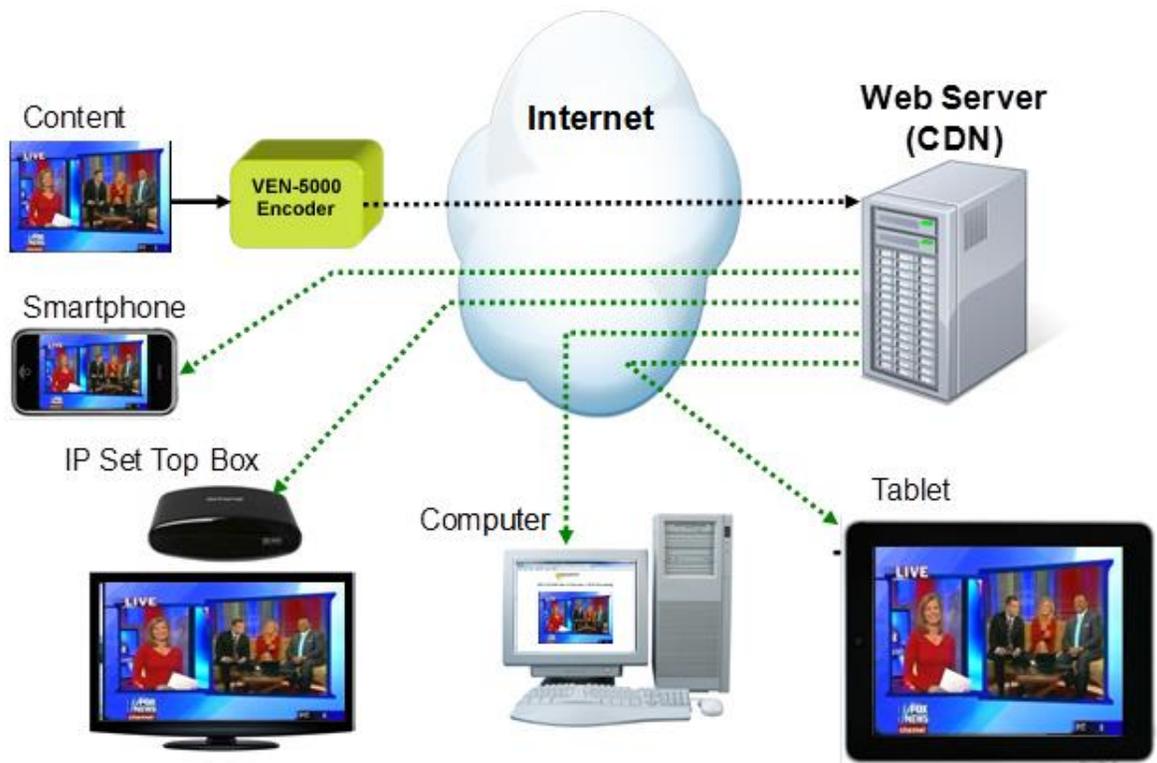
Playlists are text files, using an extension the “m3u” format. The overall process is depicted below. The client is given a link to the “Main Playlist”, where it learns the URLs of each of the individual playlists for that content, and their bit rates. The client will select one of the individual playlists based on its knowledge of its current Internet speed. The client can also switch to a different bit rate playlist on the fly, if its connection speed changes.



HTTP Live Streaming Use Case

HTTP Live Streaming is supported on the current versions of most Apple devices (iPhones, iPads, iMacs, and iPod Touch), as well as on a number of IP Set-Top boxes. On the generation side, the VidOvation VEN-5000/2000 encoder is capable of generating single-profile HLS streams and populating a standard Web server with all the relevant files, in real time, using either FTP or SFTP. For a small deployment, a standalone web server can be used; for a larger deployment, the files can be uploaded to a CDN. The diagram in the next page illustrates this use case.

VidOvation can supply the encoder and compatible IP set-top boxes for this application.



Enterprise Multicast Video

Introduction

In a properly-designed corporate network, IP Multicast can be used to very efficiently distribute video. This technology, coupled with VidOvation's VEN-5000 openGear Cards and VEN-2000 Stand-alone series of encoders, can be used to create a very compelling corporate video distribution infrastructure.

Multicast Video Distribution

Nowadays, most corporate networks are built using managed layer-3 switches from vendors such as Cisco, Juniper, Extreme or others. Most modern layer-3 switches have multicast support built-in, and ready to be turned on. What this means is:

- Multicast video only goes where it is needed. In other words, it is only delivered to a given network port (user) when requested.
- If the network spans multiple locations, only one copy of each stream is ever transmitted on the WAN link, and only if there are viewers in the remote location. This is far more efficient than using unicast, where one copy is transmitted per viewer. This way, WAN link bandwidth is conserved.

All modern PCs have the CPU capability to decode at least Standard Definition H.264 video; most will be capable of decoding also High Definition H.264 video. In addition to that, all modern desktop Operating Systems (Windows, Linux, MacOS) have appropriate support for IP multicast. The bottom line is that the average modern corporate network is likely to be ready for IP Multicast video, with little or no investment; moreover, the ubiquitous PC platforms make suitable decoders.

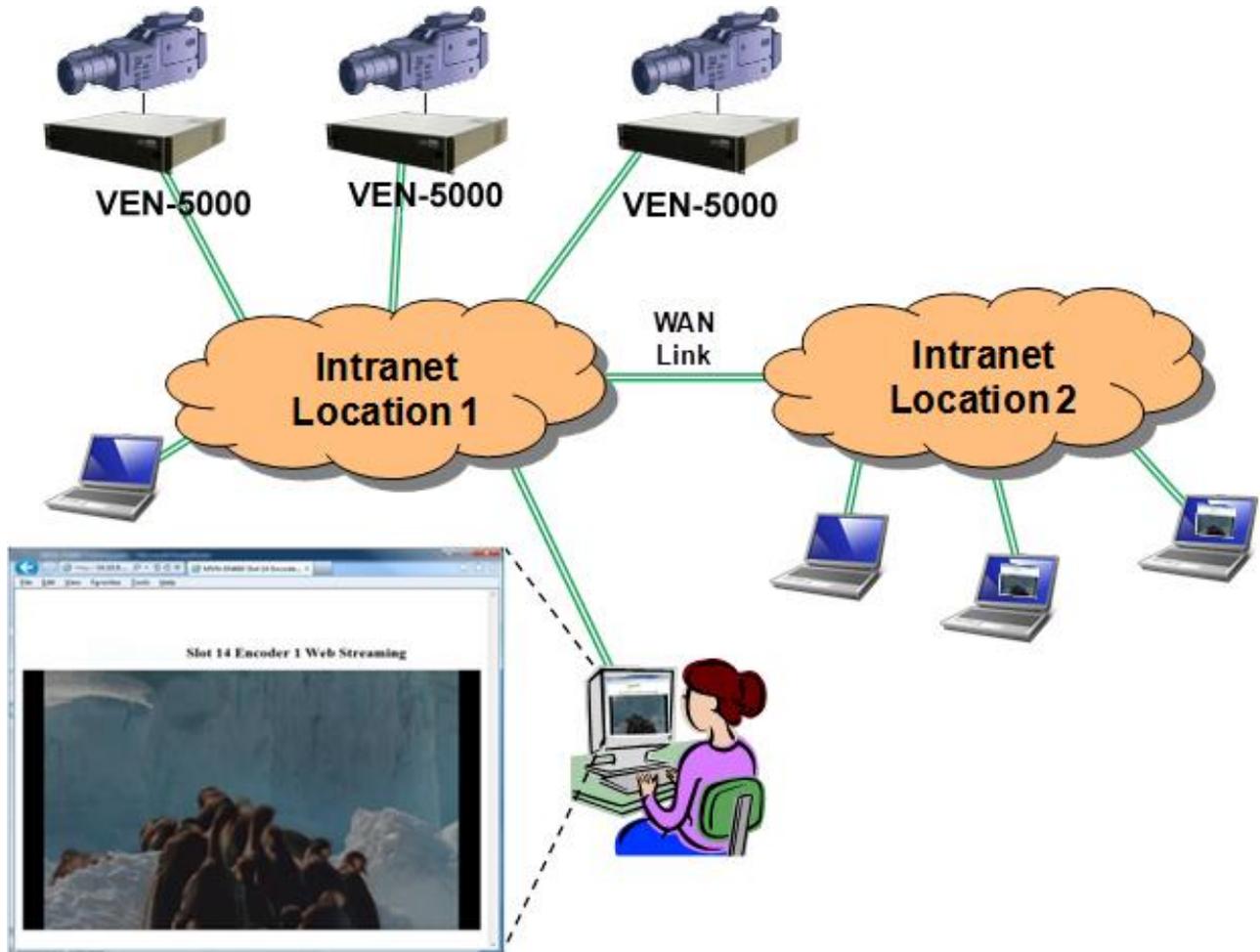
To make matters even simpler, the video should be playable in a web page, thus using a tool (web browser) users are already very familiar with.

Video Distribution Network

An example of a corporate video distribution network is shown in the next page. The highlights are:

- VidOvation VEN-5000 and VEN-2000 encoders are used to ingest the content and convert them into H.264 Video/Audio streams, transmitted into the network over IP Multicast.
- Users access the content via web pages automatically generated by the VEN5000/2000 encoders. These web pages take care of all the low-level configuration details, such as multicast addresses, streaming protocols, and UDP ports. If desired, the IT department can make a static web page on one of the intranet servers with a "channel list", pointing to the individual encoder web pages.
- The network infrastructure only transmits the multicast to PCs that have requested it. In particular, only one copy of each requested stream will be transmitted over the WAN Link,

regardless of how many users are watching it in Location 2. The stream replication for Location 2 users happens at the layer-3 switches deployed at that site.



Web-Based Monitoring

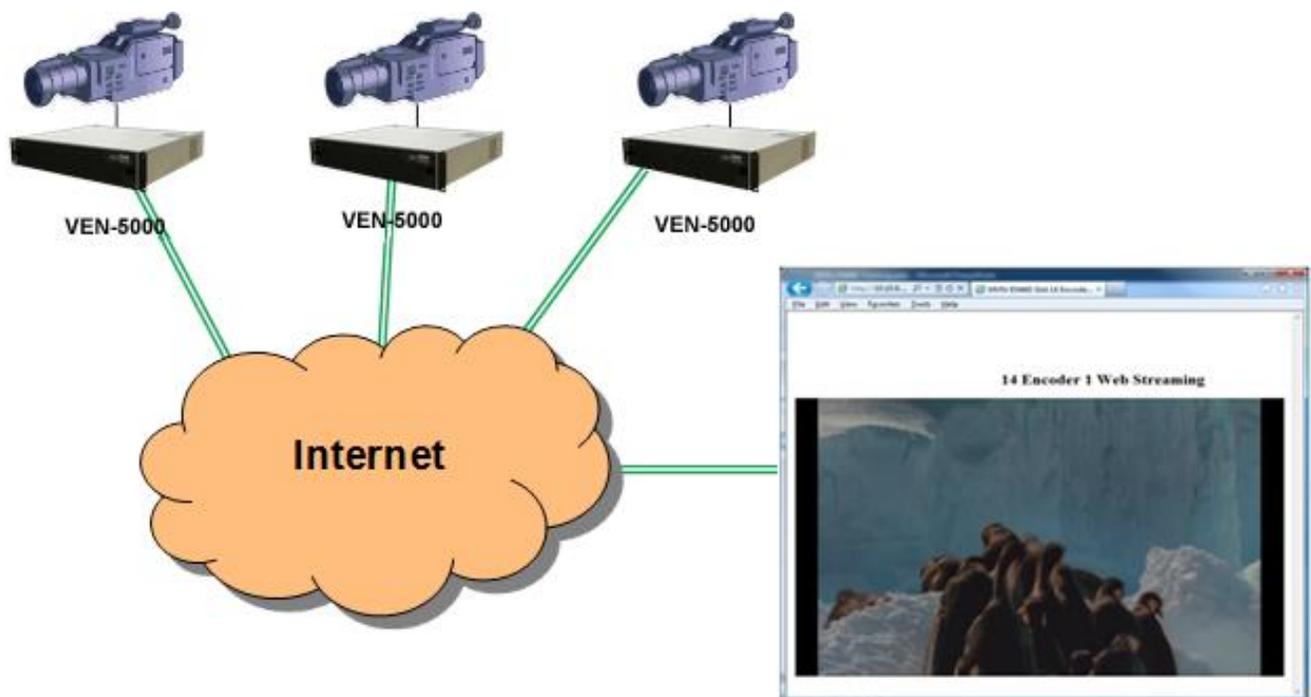
Introduction

For some applications, it may be interesting to monitor one or more video feeds over the Internet, or over a corporate intranet. Ideally, such monitoring should be done using a web browser – the user opens a link, and the video plays on a window. Another desirable feature is that no special network configuration should be needed for this monitoring.

The VidOvation VEN-5000 Encoder offers this feature. Encoders can be set in a number of ways that allow the monitoring using a web page.

Application Scenario

The application scenario is illustrated below. One or more VEN-5000 encoders are connected to audio/video sources to be monitored. In order to see the video (and hear the audio), the user simply points a web browser at the encoder's IP address, and selects the encoder channel. The video then plays on the web page, without any need for further configuration or setting up streaming parameters.



Video Delivery Options

The VEN-5000 offers two video delivery options for this application scenario:

1. If the monitoring is to be performed over the Internet, the encoder can deliver the audio/video over a standard HTTP connection. The web browser loads the monitoring page from the

encoder, and that page starts a plugin that connects to the encoder and pulls in the audio/video over HTTP.

2. If the encoder is already streaming over UDP/IP/multicast or RTP/IP/multicast, and the monitoring station has multicast connectivity to the encoder, the web page generated by the encoder will direct the monitoring station to join the correct multicast with the correct protocol. This is especially suitable for occasional monitoring on IPTV headends, where the encoder is being used to generate content for end-user set-top boxes.

If you have a dual-channel VidOvation VEN-5200 encoder, the following application scenario is possible:

- Use one channel as your primary encoder channel, encoding at full resolution (possibly HD 1080i or 720p). The primary encoder can come out in any of the supported outputs (UDP/RTP multicast, ASI, etc.), and will be your application feed.
- The second channel is used for monitoring. Configure it to take the same input as the primary channel, and for one of the low resolutions; for example, 320x240. The bit rate can be set to a low value. This channel is then configured to deliver the bitstream over HTTP.
- If you need to monitor your primary feed from a remote location, just use a web browser to connect to the low-resolution version of the content, available from the second channel. Since this is low bit rate, it can be done through the Internet without any special requirements.

Feel Free to See VidOvation TV Here



Thank you for your interest in our white paper "An Introductory Guide to IPTV". Please contact us for anything else you would like to know. Thank you.

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