



VBrick and MPEG-4

It's not just lower bandwidth

VBrick Systems has a proud history delivering high quality live video over digital networks to desktops and TV monitors. VBrick invented the Video Network Appliance back in 1998 and was the first to make live MPEG-1 video reliable and affordable. VBrick was the first to make live DVD-quality MPEG-2 video available to desktops for free. And now VBrick is the first to deliver live, standards-compliant MPEG-4 video in a multi-functional, reliable appliance.

This paper sets the stage for VBrick's MPEG-4 product introduction, and illustrates the many differences between high bandwidth and low bandwidth video delivery.

A Bit Of History

The delivery of MPEG-2 requires at least 2 Mbps (MPEG-1 is about half that). This is a trivial amount of bandwidth for an appropriate network, and from the White House to Wall Street, there are many thousands of people viewing live MPEG-1 and MPEG-2 video from VBrick appliances today.

But the "appropriate network" is a *dependency*, and not everyone can identify whether his or her network falls into this category. Further, there is high interest in delivering video to networks that were heretofore, *inappropriate*. This includes networks that do not support multicasting, networks that support multicasting but have pockets of users without multicast support, users connected to a corporate VPN, and users who only have conventional public Internet access. In other words, there is interest in sending video to everyone everywhere at any time.

Beyond the above question of "reach" (i.e. the ability of a large audience to see the video), there is interest in using less bandwidth even when sending a multicast video. This is true because a multicast video still has to contend for oversubscribed "uplinks" when it leaves a workgroup.

MPEG-4

It is correct to think of "MPEG-4" as a video compression capability that is a multi-vendor International Standard. It is correct to think about "MPEG-4" as producing excellent video quality for a given display size and bandwidth. It is also correct to think about "MPEG-4" as enabling VBrick appliances to operate at lower bandwidth.

But it would be *wrong* to think the story ends there! While MPEG-4 certainly does these things, VBrick has implemented features and functions that make the above not only true but also extraordinarily useful, as we will next explore.

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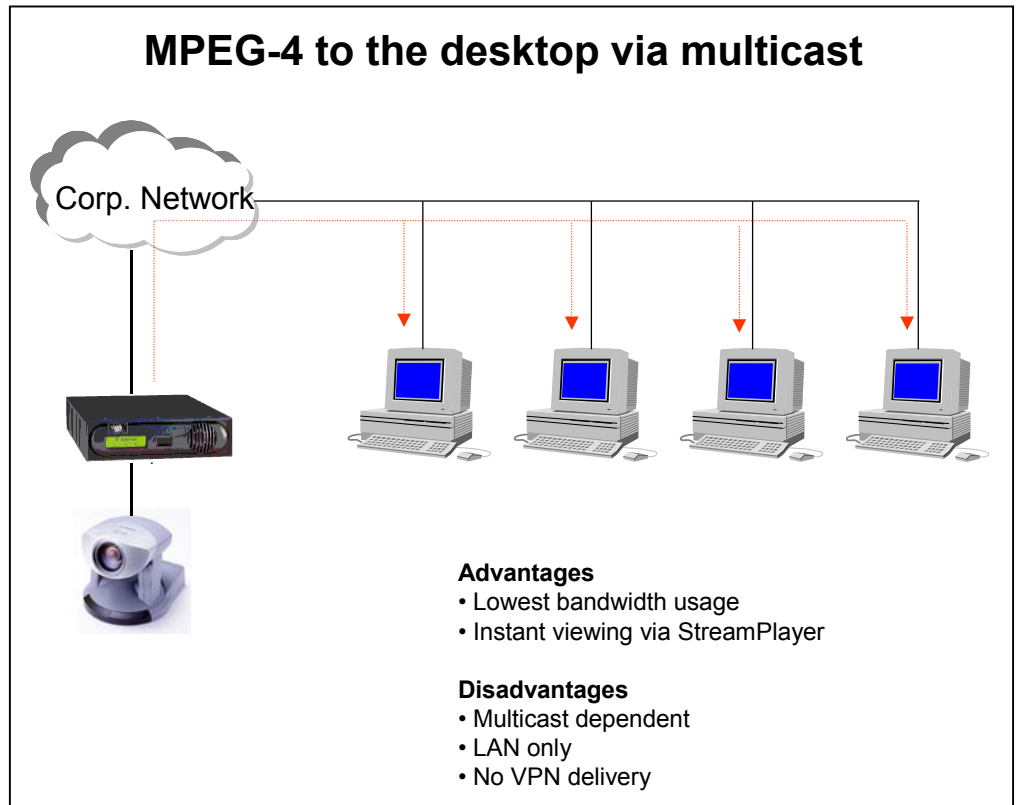
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Multicasting MPEG-4

VBrick is among the world's leaders in multicasting video. For those familiar with multicasting via the VBrick 3000 and 6000, MPEG-4 is very similar but uses less bandwidth to produce good video.

One need merely plug a VBrick into their network, and every desktop on that network may view the live MPEG-4 video using their StreamPlayer viewer, or using a custom web page.

From a user's perspective, they can view live MPEG-1, MPEG-2 or MPEG-4 video without knowing any more than how to click on a Program Name.



Multicasting MPEG-4 uses up to *ten times less* bandwidth than MPEG-2 for applications that call for partial-screen video display¹. For small screen display, the quality is nearly equivalent to MPEG-2. For full screen, MPEG-2 is clearly superior. This low bandwidth usage encourages extended deployment and helps to prevent the saturation of router uplinks.

As with any multicast, the network must support IGMP, and it does not work in older networks or those networks built using inexpensive hubs and switches.

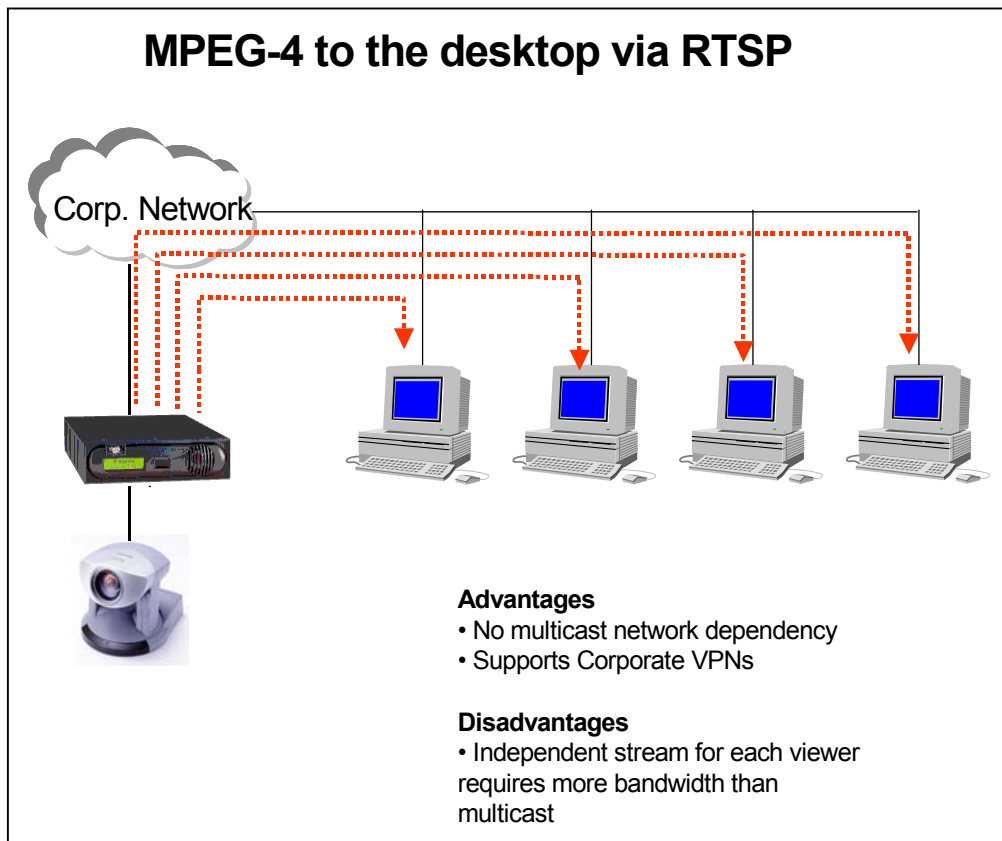
¹ Assume MPEG-2 at 3 Mbps and MPEG-4 at 300 Kbps, and assume both are displayed in a small video window on a PC monitor. The point is, the smaller the viewing window, the less of a distinction between MPEG-1, MPEG-2 and MPEG-4. For full screen display, MPEG-4 at 300 Kbps might best be called "bad" while MPEG-2 at 3 Mbps might be called "very good". But both might be equally regarded as "excellent" when viewed in a very small window. It should be noted that MPEG-4 at 2 Mbps, even at full screen, might be regarded as "very good" and looks like normal VHS tape, while MPEG-2 at 4 Mbps would be consistently regarded as "excellent" at all screen sizes.

VBrick and RTSP Server

For those familiar with VBrick and multicasting, the new capabilities available with the VBrick solution requires a fundamental shift in thinking. The Real Time Streaming Protocol (RTSP) and the integral VBrick Video Server (VVS) conspire to deliver a new world-class video streaming solution.

In this new model, a desktop client (whether a VBrick StreamPlayer, a Real Networks player, a Apple Quicktime player, or Microsoft Media Player with the VBrick plug-in) makes a direct request to a VBrick. The VBrick responds to the request by sending MPEG-4 audio/video directly to the requester via unicast. In this model, *every viewer receives their own stream* and the network need not support multicast at all.

Corporate Virtual Private Networks (VPN's), for example, do not support multicasting. With VBrick's MPEG-4 product, the VPN user simply requests the video and the VBrick delivers it to them via unicast UDP.



This capability works in virtually any and all IP networks, including the Internet. In a local area network, this capability eliminates any dependency on multicast, but this comes with a price. When every client has their own stream, the VBrick (and hence the network port it is connected to) can reach very large total bandwidth numbers. For example, 100 people viewing a 300 Kbps stream would require (100 x 300,000) 30 Mbps. Were the same 100 people to view via multicast, only 300 Kbps total bandwidth usage would be required.

VBrick and MPEG-4 Webcasting

That VBrick delivers MPEG-4 audio/video at bandwidths from dial-up to DSL & Cable Modem speeds is certainly noteworthy. The astute observer will note that there is nothing preventing the video from being viewed over the Internet directly from a VBrick.

This is indeed the case.

However, local network dependencies quickly come into play, both on the side of the sender (the VBrick location) and the receiver (the viewer).

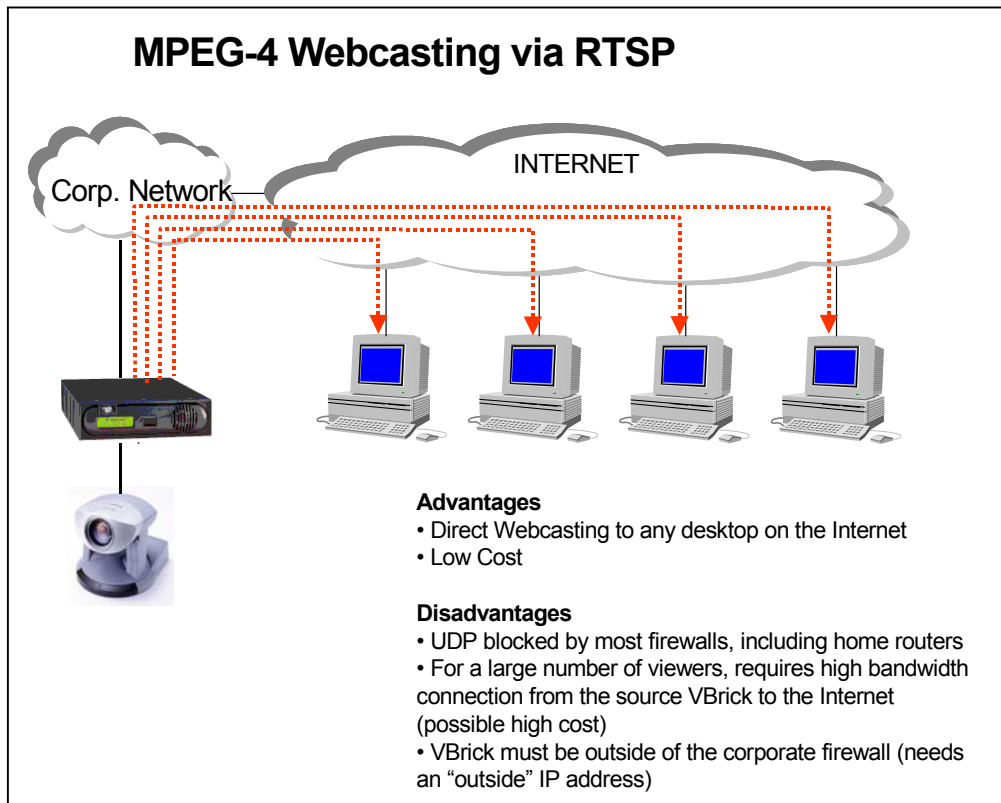
For the video to be viewable on the Internet, the VBrick server (the VBrick itself) must be reachable from the Internet. This means it must be

configured with a unique "outside" IP address, or the local router must conduct Network Address Translation. This is not at all hard to do, but it does represent both a dependency and a potential security concern for the network manager.

A deeper concern is that the VBrick delivers its video via UDP, which is exactly the right thing to do. But many firewalls, both corporate and even home gateway router devices, may block all UDP traffic making it impossible to view the VBrick video.

As with any unicasting solution, another issue is the Wide Area Network bandwidth usage required to support a large number of Internet video viewers. If the source VBrick is connected to the Internet via a T1 or E1 (typical corporate access bandwidth), delivering video to just five users at 300 Kbps will consume the entire capacity ($300 \text{ Kbps} \times 5 = 1.5 \text{ Mbps}$).

For viewing by only a few remote workers, or for companies with large WAN access connections, this may not be an issue.



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VBrick and MPEG-4 Hosted Webcasting

Webcasting is a powerful tool to deliver a compelling live message to virtually everyone, anywhere in the world. The nature of live attracts and retains viewers, and it obviously delivers the same message to everyone at the same time. Viewers of live webcast streams may be easily given the opportunity to ask questions or give live feedback via many “Instant Messenger” services, “chat pages”, or even plan old telephone.

But it may be unreasonable for an enterprise to install a multi-gigabit Internet access connection to support hundreds or thousands of live viewers, especially if it is to be used for only one hour once a week!

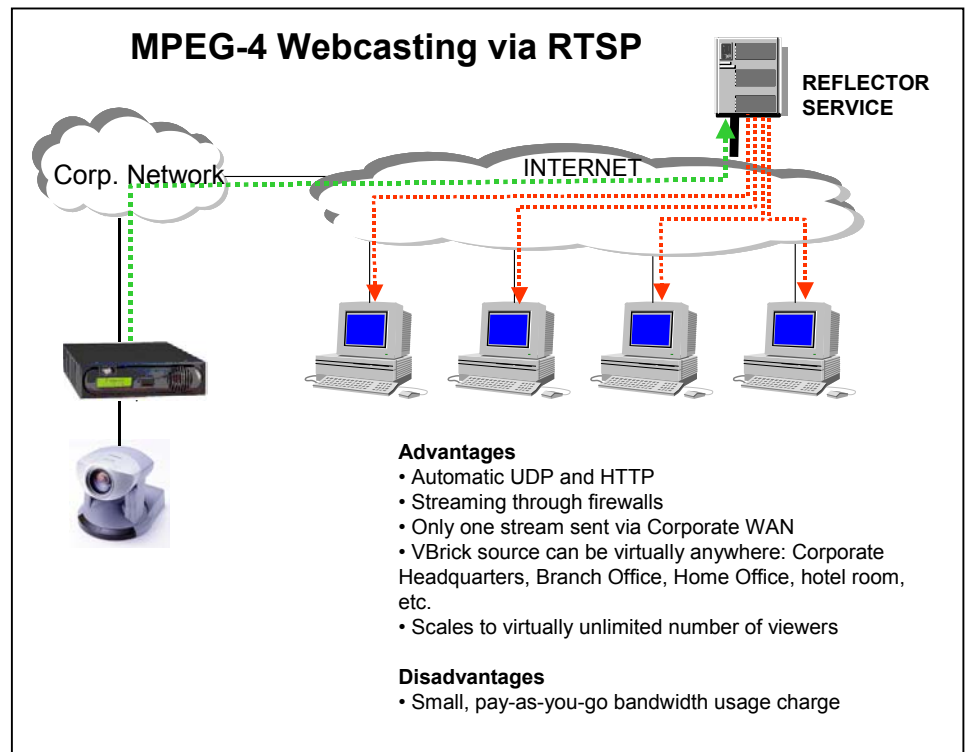
Furthermore, there is interest in delivering the live webcast from anywhere at any time...from your office, from a boardroom, from a hotel room, or even from your home.

VBrick supports the unicasting of a stream to an external “Reflector Service”. The Reflector is simply a high performance server that is connected to the Internet via multi-gigabit connections.

The VBrick delivers one stream to this Reflector (for example, one 300 Kbps stream), and the Reflector replicates the stream to any client that requests it.

Importantly, the Reflector is able to negotiate with client viewer. If the client viewer is unable to view the (preferred) UDP stream, it will deliver the MPEG-4 stream via HTTP (which requires some 30% more bandwidth, but does get through firewalls).

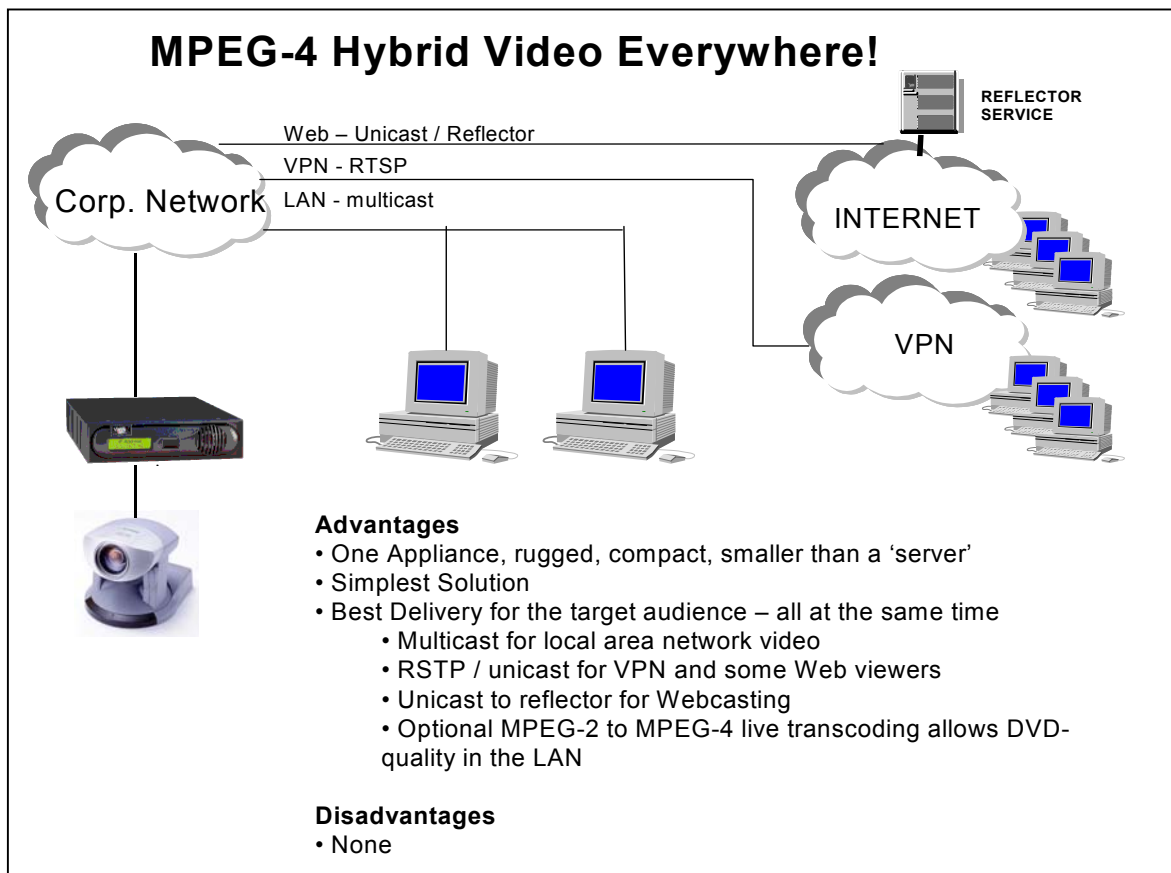
Because the VBrick sends the video only to the Reflector, the VBrick does not need an “outside” IP address and can be placed virtually anywhere in any network that will support the single-stream bandwidth you have configured.



Putting It All Together – The Hybrid

We have examined MPEG-4 multicasting, RTSP, and UDP unicasting. But it is vital to understand that VBrick does all of these things at the same time in the same appliance!

This is not a “Swiss Army Knife” proposition to solve some unknown problem, nor is it some unintended artifact. It is a necessary, and revolutionary solution to very real and very complex problems. Moreover, the simultaneous support for multiple modes of operation makes the VBrick truly easy to use because it eliminates so many external dependencies.





Ready...Set...

A single VBrick can truly provide video everywhere by applying the best technology to the problem at hand:

- Multicasting the Local Area Network which saves bandwidth
- Automatic RTSP unicasting in the Local Area Network for locations that do not support multicasting
- RTSP unicasting in the corporate VPN to reach remote employees anywhere in the world
- Direct webcasting
- Unicasting to a Reflector service to provide webcasting scale

Plus, the same VBrick also simultaneously supports live MPEG-2 encoding or decoding. This powerful combination provides:

- Low bandwidth MPEG-4 for bandwidth-challenged viewers, and DVD-quality MPEG-2 video delivered to local desktops via multicast.
- Live, real-time transcoding of MPEG-2 network video to MPEG-4 video streams
- ...and the other award-winning VBrick functions and features already being used around the world for security, education, media distribution, and more.

Coupled with a VBrick automatically-downloaded-and-installed MPEG-4 decoder plug-in, StreamPlayer, and other VBrick system elements, virtually unlimited, standards-based, reliable, live video is a reality.