

TVU Grid: Live IP-Based Video Switching, Routing and Distribution Solution

Introduction

Broadcast television is entering a new era. Much like the move from analog to digital earlier this decade, broadcasters are experiencing another seismic shift as stations begin the transition to a completely IP-based infrastructure within the television station.

The move to standardize over IP is a logical evolution for broadcasters, as IP infrastructure is already ubiquitous and large amounts of bandwidth are readily available throughout much of the world. Over the years, IP has also played a significant role in content acquisition and distribution. However, despite the proliferation of IP, broadcast facilities are still built with legacy digital infrastructures, requiring costly equipment to encode, decode and transcode disparate analog, IP and digital sources to SDI so it can be ingested into the workflow and converted to a usable broadcast signal.

For a vast majority of broadcasters, one of the biggest challenges inherent in this internal device sprawl and network complexity is the challenge of sharing live video cost effectively in real time. Because of the complex infrastructure and myriad video sources, broadcast stations have been forced to implement a siloed operational approach, which is especially problematic for stations affiliated with a larger station group or broadcast network. Until now, sharing live video in real time between stations has required additional encoding equipment and expensive satellite time, and has slowed broadcasters' ability to fully leverage existing IP infrastructures.

A New Solution

To that end, TVU Networks has developed TVU Grid to help broadcasters fully leverage the promise of IP and simplify their ability to share live video in real-time in a simple and cost effective manner. TVU Grid is a dynamic IP-based video switching, routing and distribution solution that enables broadcasters to tear down the walls of the broadcast station and acquire live video from any source and distribute it to other broadcast stations.

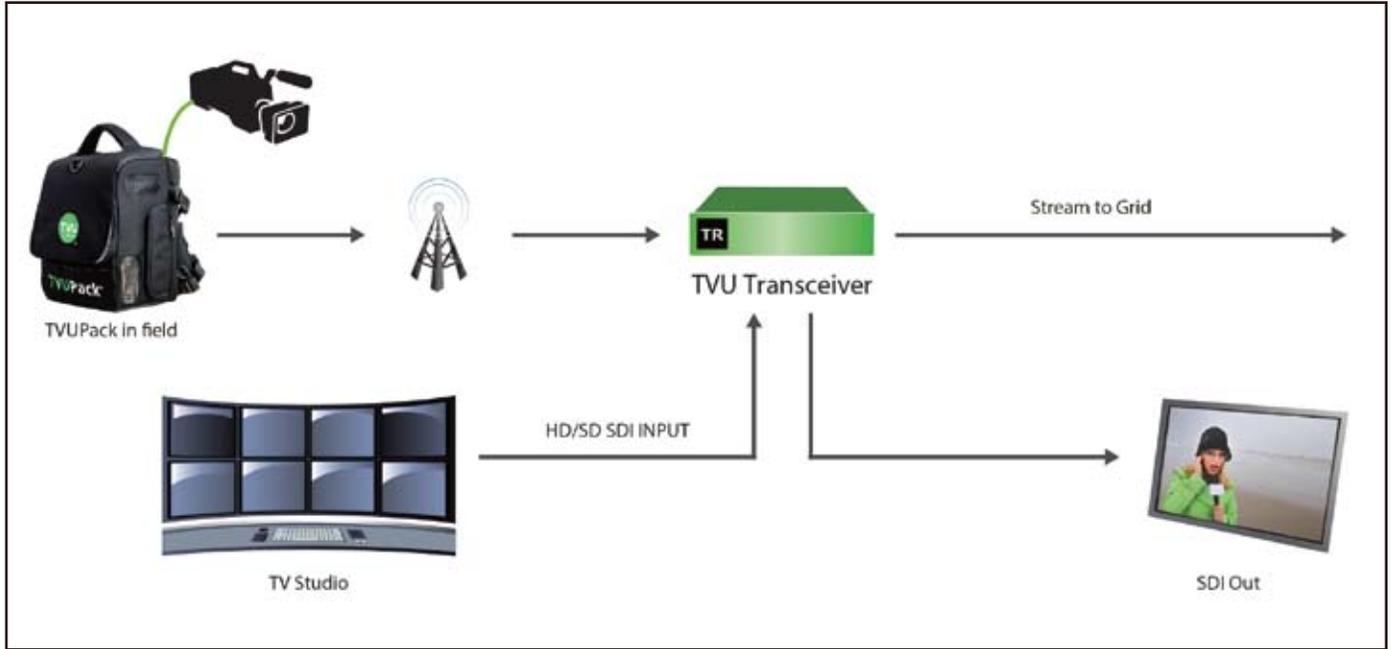
Before we discuss the various use cases for TVU Grid, it is necessary to define each of the individual components that comprise the Grid.

TVU Transceiver

The TVU Transceiver is the primary component of TVU Grid, enabling stations to share live video in real time. The TVU Transceiver is a custom built appliance that sits in each television station and connects it to the Grid. The TVU Transceiver can accept video input from any source, whether it be from other stations connected to the Grid, from the TVUPack transmitter – TVU's cellular uplink solution capable of streaming live video from the field over 3G/4G/LTE, WiFi, satellite or microwave links – or from any other SDI source in the station.

The TVU Transceiver works over any IP network with sufficient bandwidth. Although the TVU Transceiver can only receive one stream at a time, it is capable of feeding two streams to the Grid simultaneously, enabling television stations to upload live ENG shots as well as video from an SDI source in the studio at the same time with minimal latency. The Transceiver also enables stations to feed video to other locations in multiple video formats. As a result, they can push streaming video to other platforms beyond over-the-air broadcast, such as a content delivery network (CDN).

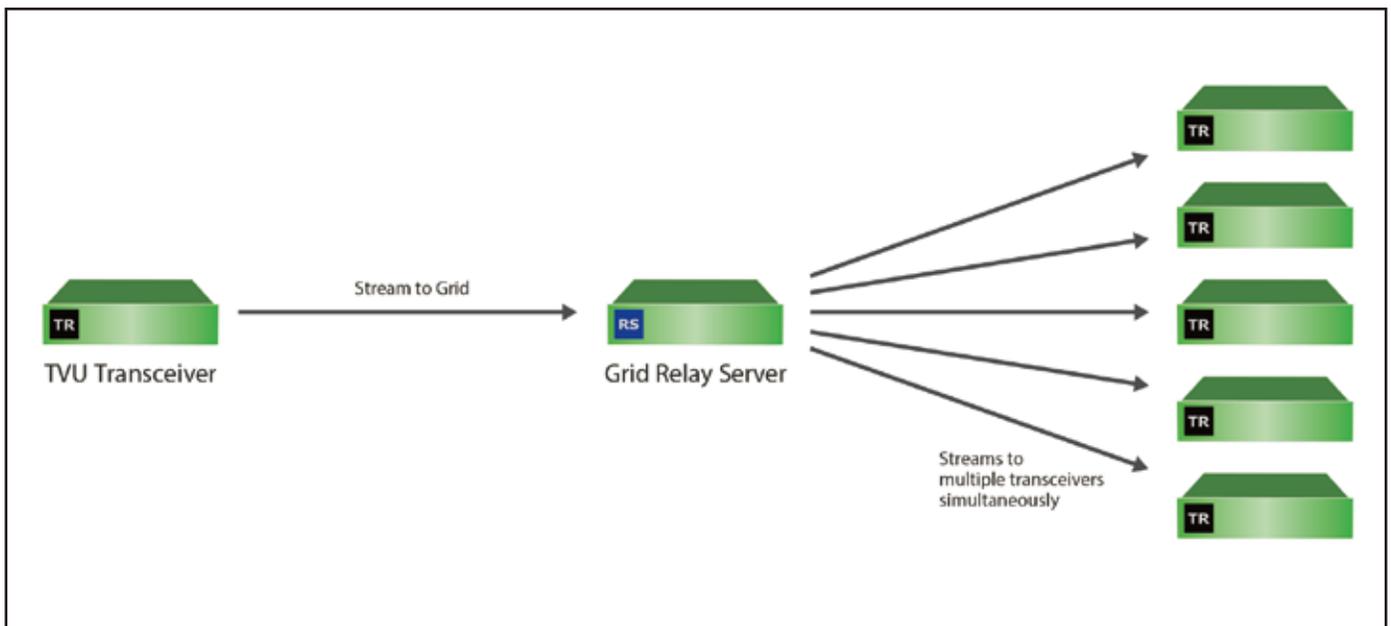
The following diagram gives a brief example of how the TVU Transceiver fits into a broadcast station's Grid and ENG workflow.



TVU Grid Relay Server

The TVU Grid Relay Server is a powerful switching and routing hardware appliance that is housed in a broadcast group’s primary data center or in the cloud. When connected to two or more TVU Transceivers, the Grid Relay Server dramatically expands the scalability of the Grid network without increasing bandwidth requirements at each individual station connected to the Grid. Broadcasters can deploy the Grid Relay Server appliance in their own data centers or can license a cloud version of the appliance managed by TVU. The Grid Relay Server’s primary benefit is to enable broadcasters to scale the number of stations connected to the Grid without dramatically increasing bandwidth requirements at each individual station.

The following diagram demonstrates how the Grid Relay Server fits into the Grid workflow.

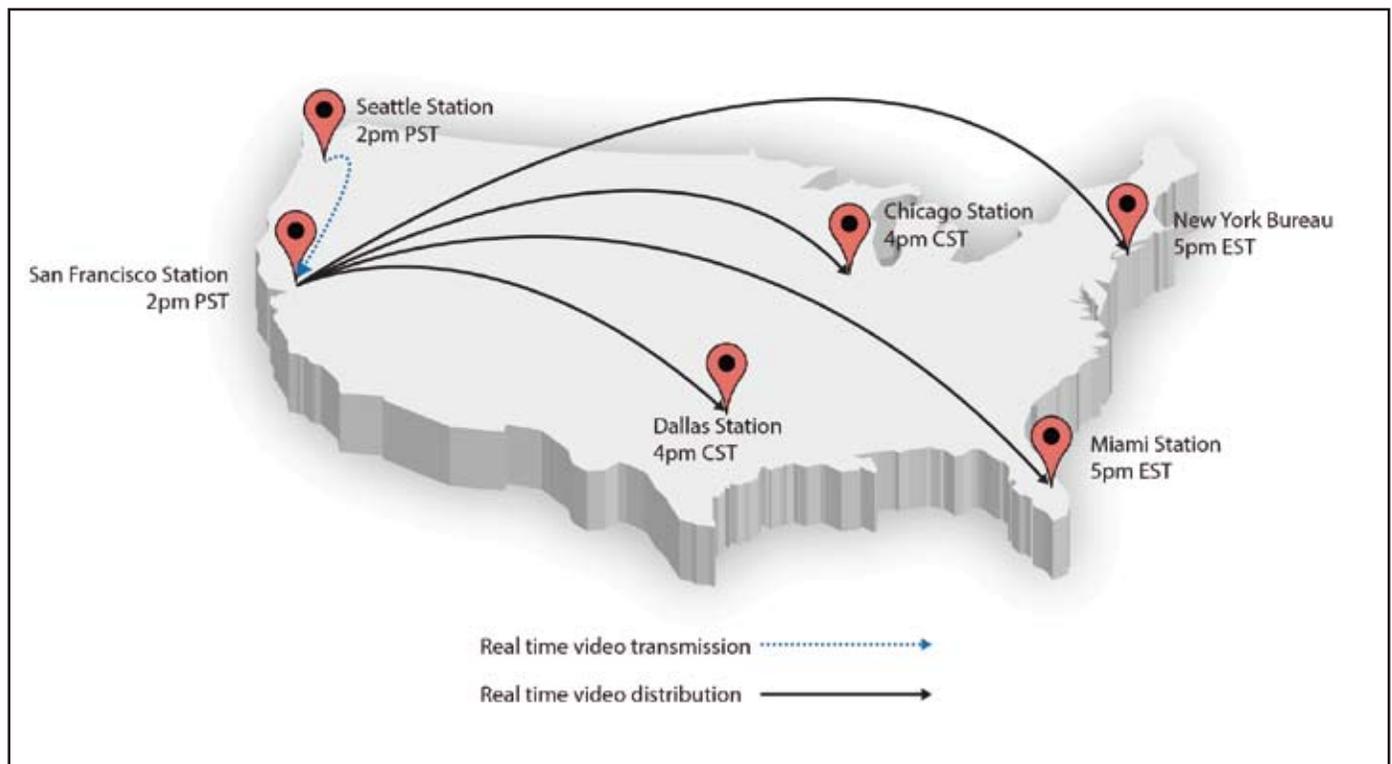


Basic Functionality

At its core, TVU Grid is a network of devices that connects broadcast facilities in different locations to one another and gives them the ability to instantly share live video streams. To save on bandwidth requirements at each location, TVU Grid employs an on-demand pull model, enabling stations connected to the Grid to see any available stream and request it with the click of a mouse.

For the requested video content to stream across the Grid from the origin to other locations, the Transceiver first takes the original signal coming from a TVUPack or SDI feed, encodes it to an IP stream, and transmits the encoded stream to the Grid Relay Server. The Grid Relay Server then takes the incoming IP stream and distributes it to any Transceiver on the Grid network that requests the stream from the source. The stream can be simultaneously distributed to an unlimited number of destinations, ensuring that high profile video of important breaking news and events can be easily shared across a large number of locations.

The following diagram outlines the flow of the stream from the original source to another location on the Grid.



Scalability

TVU Grid is designed to easily scale to meet the requirements of any size broadcast organization. The scalability of the system is only limited by bandwidth availability at each station and in the datacenter if the Grid Relay Server is deployed. To share full HD video across the Grid, the bandwidth requirement is 8 Mb/s per stream. SD video requires 2.5 Mb/s bandwidth per stream. Specific bandwidth requirements for various use cases of TVU Grid are described in detail later in this document.

Central Control and Management

TVU Grid employs a simple, user-friendly interface that enables the end user to efficiently switch and route between incoming streams with the click of a mouse. TVU provides two solutions to help newsrooms seamlessly switch between feeds.

Grid Switch

The TVU Grid Switch is a Web-based GUI that acts as the central control interface for the Grid system, enabling users to manage and switch between all available streams on the entire Grid network. Grid Switch offers administrator control for rights management, and switching between streams is as easy as clicking a thumbnail image displayed on the GUI. Grid Switch is accessible from any Internet-connected device with a Web browser, including tablets such as an iPad.

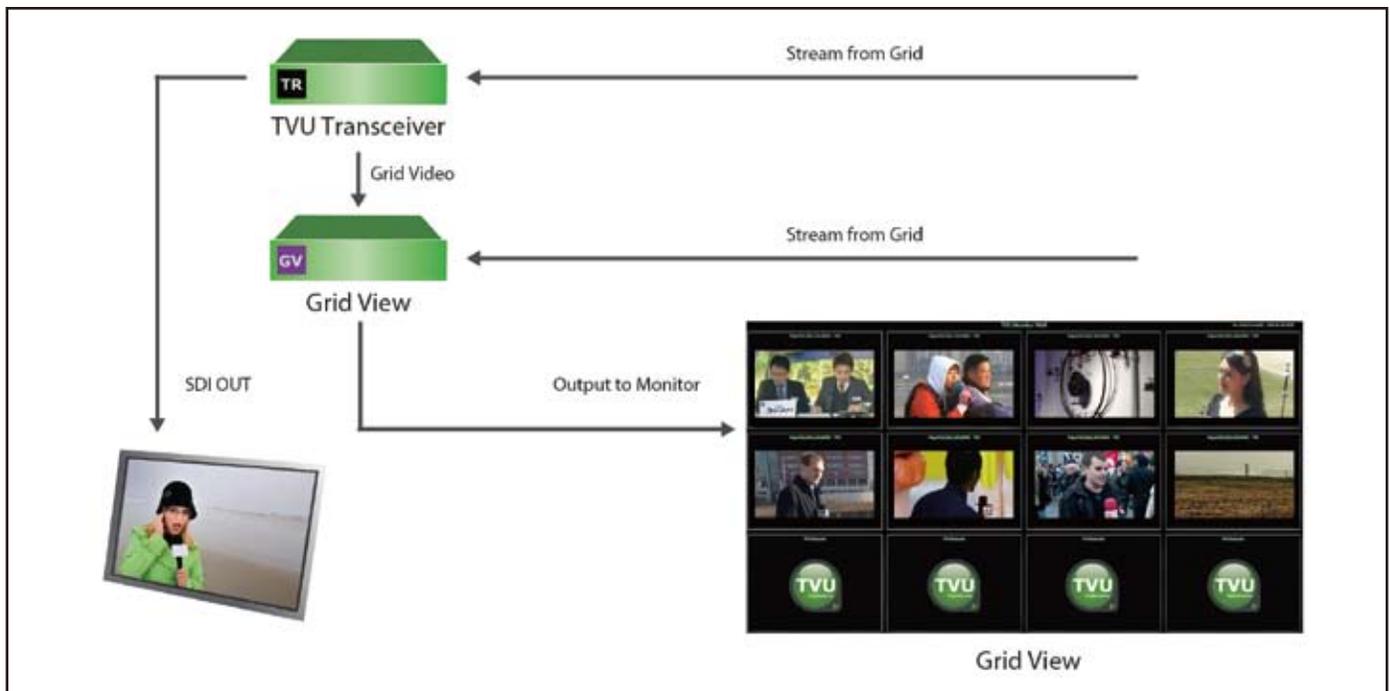


Frame Accurate Switching

One of the principal benefits of TVU Grid is the solution's frame accurate switching functionality. Frame accurate switching enables the end user to switch between multiple live streams on the Grid in real time with no latency. The benefit of this functionality is that stations can take multiple streams live and switch between them without noticeable transitions or dead air.

Grid View

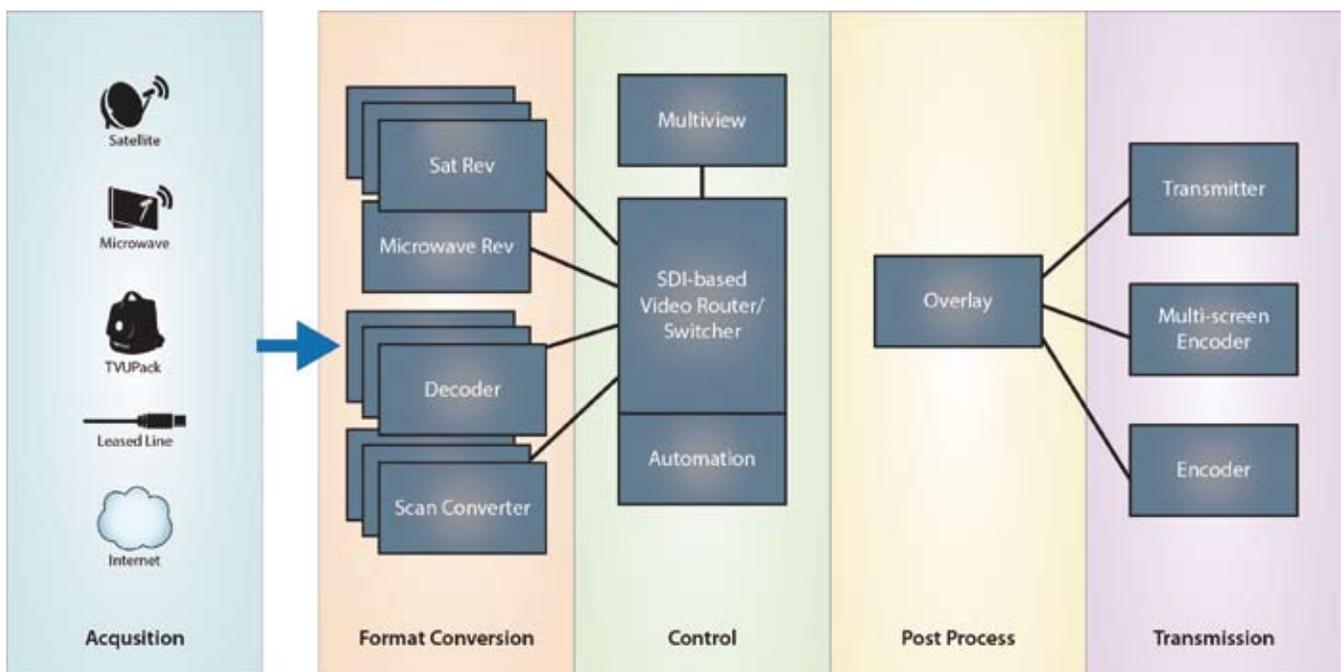
In addition to Grid Switch, TVU also offers Grid View, a hardware appliance that gives users at each individual station the ability to monitor each live stream in real time. With Grid View, users can get better visibility into the video offered by other stations. It is important to note that there are differences between the TVU Grid's standard Grid Switch GUI interface, which gives users a preview of each available stream using a static thumbnail image and the Grid View, which gives users a live video preview of each available stream. Although the TVU Grid solution will function without the use of Grid View, the appliance is required to output the live video streams in preview mode.



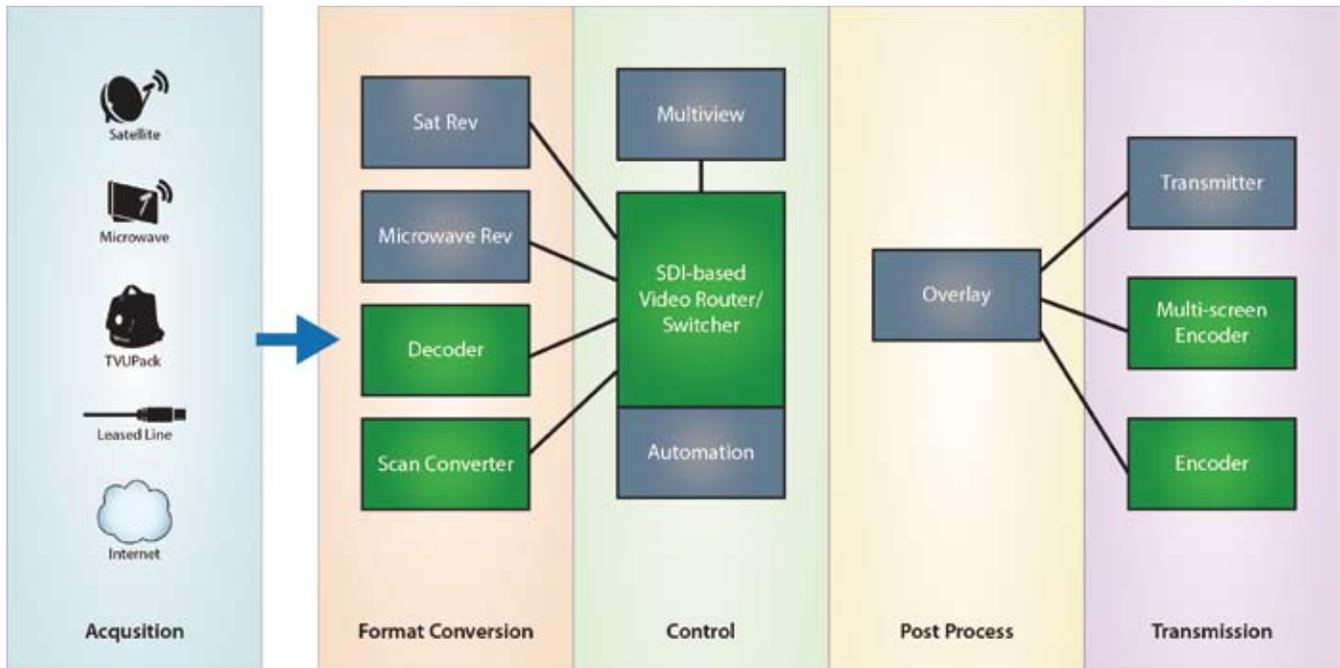
Transitioning to an All-IP Infrastructure

One of the central benefits to TVU Grid is that the solution enables a broadcast station to accelerate its ability to move to an all-IP based internal infrastructure. To understand how TVU Grid can accelerate the move to IP, let's first examine the basic infrastructure of a television station today.

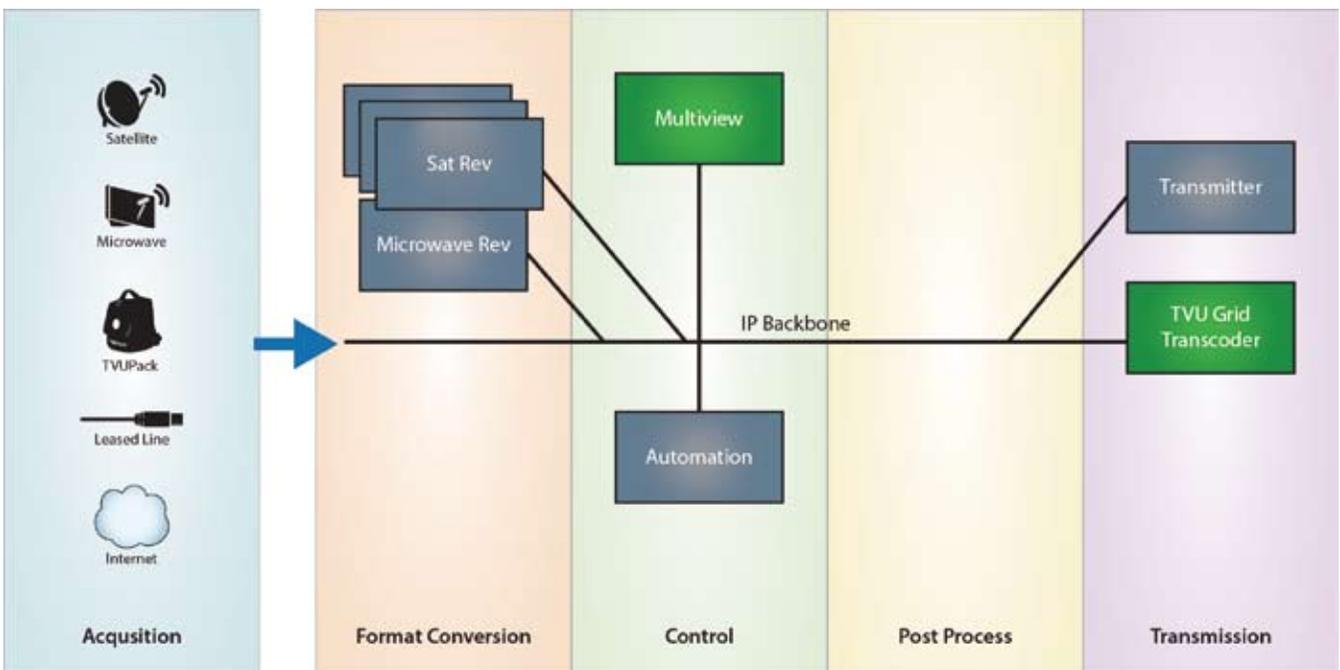
As we see in the following diagram, all video transmissions pass through four phases en route to being broadcast: acquisition and format conversion, control, post process and transmission. As a video stream enters into the workflow over IP, the stream must pass through a series of decoders, scan converters to convert the stream to SDI before it passes through the station's automation, internal switchers and routers and post processes. At that point, the stream must be re-encoded for final transmission.



With TVU Grid’s IP-based switching and routing functionality, stations are able to eliminate a number of devices within the station’s internal workflow. The decoder and scan converter can be eliminated from the content acquisition stage, the multiview system and SDI-based video router and switcher can be eliminated from the control phase, and Grid replaces multiple encoders currently required during the transmission phase.



The following diagram shows the infrastructure layout for a station that has deployed TVU Grid. As the video stream enters the broadcast facility from any source, the signal moves along the station’s IP backbone without needing to be converted to SDI. With TVU Grid, only one encoder along the entire workflow is necessary.



TVU Grid Use Cases

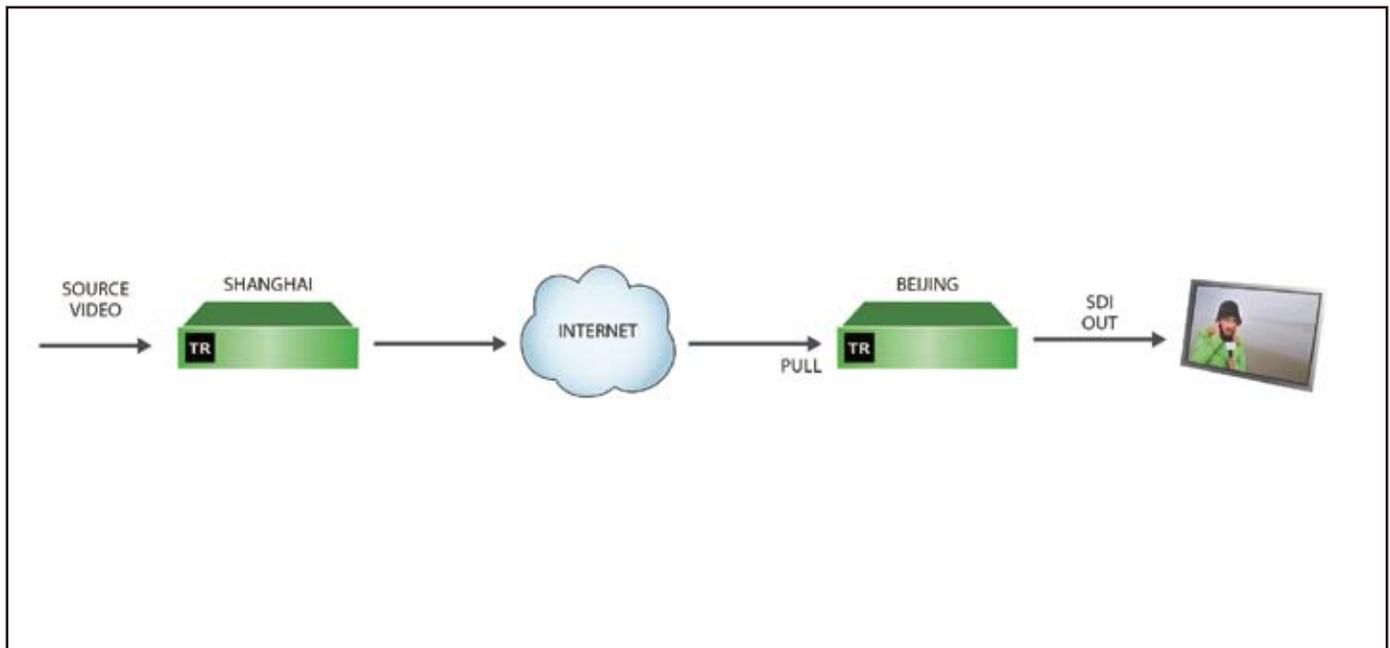
TVU Grid is a versatile solution that is capable of scaling to meet the needs of any size organization. The following section of this document will give an overview of the various deployment scenarios for TVU Grid and how it might fit into any broadcast workflow.

Use Case One: Point-to-Point (No Grid Relay Server)

The most simple use case for TVU Grid is a point-to-point configuration designed to share content between two broadcast stations in real time. To accomplish this, the configuration is as simple as each station deploying a TVU Transceiver. The Transceiver units are then configured to communicate with one another and are capable of simultaneously sending and receiving two streams per transceiver.

This configuration benefits smaller broadcasters looking to share content between two stations without requiring expensive satellite uplink time and expensive encoding equipment. To share HD content in this configuration, each site will require 8 Mb/s of bandwidth for every stream. Each station will require 2.5 Mb/s of bandwidth per stream for SD. In this simple configuration, the Grid Relay Server is not needed.

The following diagram outlines a sample network configuration between two stations in Shanghai and Beijing. The Transceivers at each station are connected via the Internet and are capable of sharing any video stream transmitted to each individual Transceiver. As news breaks in Shanghai, the user in Beijing pulls the stream with video of the breaking story directly from the Shanghai receiver for immediate broadcast to viewers in Beijing.

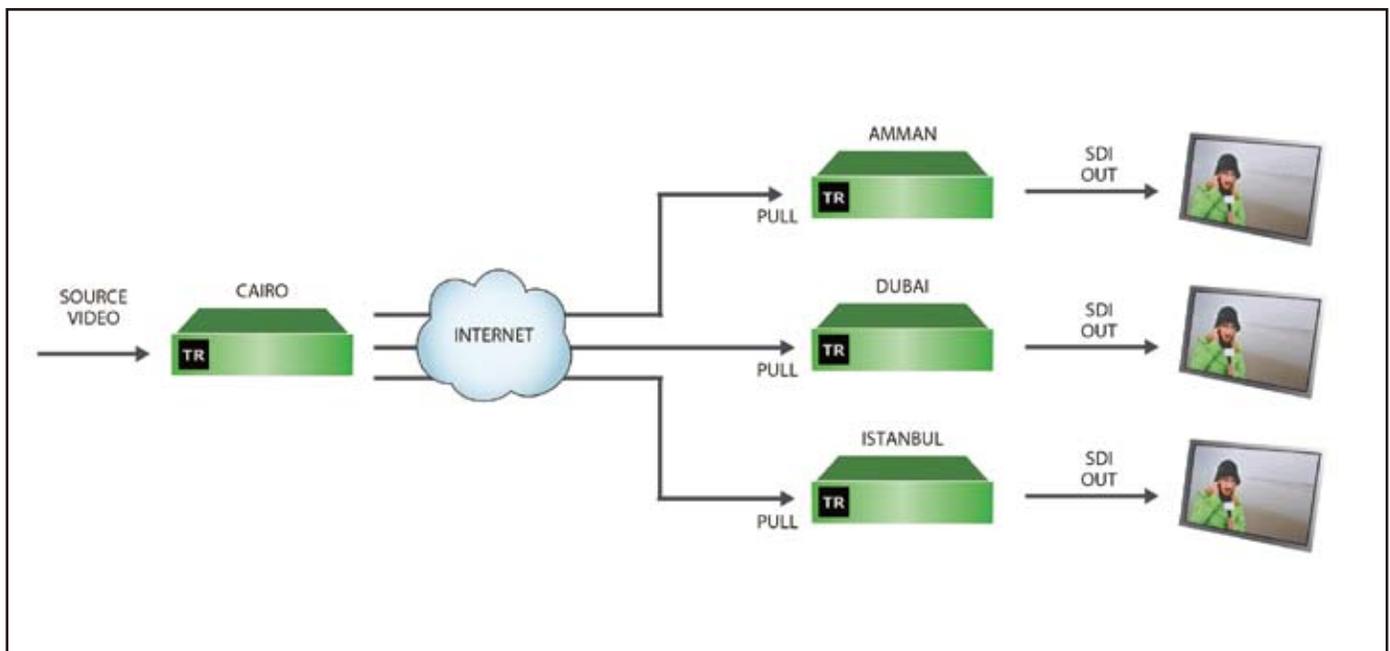


Use Case Two: Point-to-Multiple-Point (No Grid Relay Server)

This use case is designed to accommodate small station groups looking to share video streams from one point to multiple points without the use of the Grid Relay Server. To accomplish this, TVU Transceivers are deployed at each individual station and are configured to communicate with each Transceiver within the Grid network. This configuration enables each of the stations to pull content from any other station connected to the Grid. However, because of the absence of a Grid Relay Server, scalability is limited to the bandwidth available at each station.

Bandwidth requirements in this configuration are larger than that of the point-to-point configuration. To share HD content in this configuration, each site will require 8 Mb/s of bandwidth per stream. Each station will require 2.5 Mb/s of bandwidth per stream for SD. As a result, the total bandwidth requirement at each station in this configuration is entirely dependent upon the number of stations connected to the Grid. The Grid Relay Server is not required in this configuration.

The following diagram outlines a configuration where a station located in Cairo has deployed TVU Grid to share video content with its affiliates in Amman, Dubai and Istanbul without the use of a Relay Server. With TVU Transceivers deployed at the edge of the network in each location, the Amman, Istanbul and Dubai stations can all simultaneously pull a live stream broadcast by the station in Cairo. Because there is no central Relay Server routing the content, bandwidth requirements at each station connected to the Grid are higher. In this case, the Cairo station would require 24 Mb/s of bandwidth to accommodate the three simultaneous HD video streams.

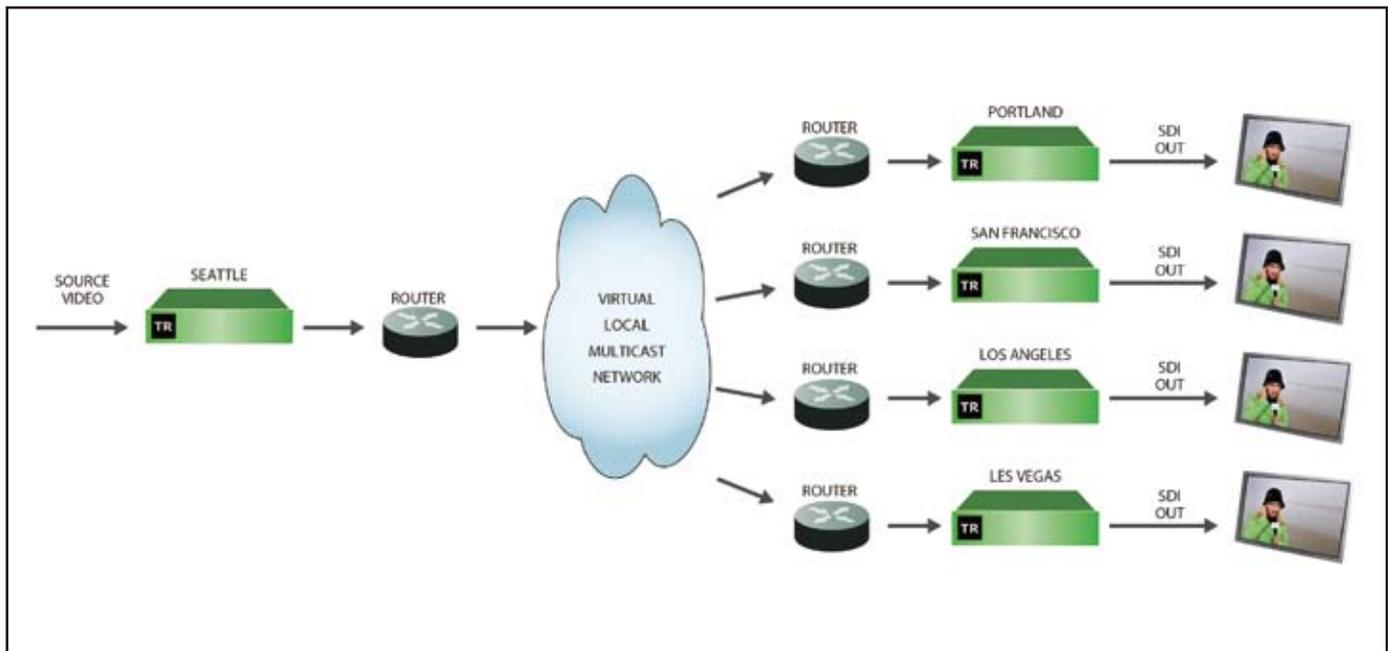


Use Case Three: Multicast (No Grid Relay Server)

This use case is designed for large broadcast organizations that already have a multicast infrastructure in place. In this case, the TVU Transceivers are deployed at each individual station and are capable of integrating into the multicast workflow already deployed at the station group. The Transceivers at each station sit at the edge of the network and output incoming video streams into the station’s SDI matrix system.

With this configuration, bandwidth at each location is less of an issue due to the nature of the multicast network implementation. Because the station group already has a multicast infrastructure, the Grid Relay Server is not needed in this configuration.

The following diagram outlines a use case where a group of 35 stations based in the United States integrates TVU Grid into their existing multicast workflow to ensure real-time video sharing between stations. In this example, the group’s affiliates based in Portland, San Francisco, Los Angeles and Las Vegas are all interested in simultaneously pulling down video content being streamed by the affiliate in Seattle.



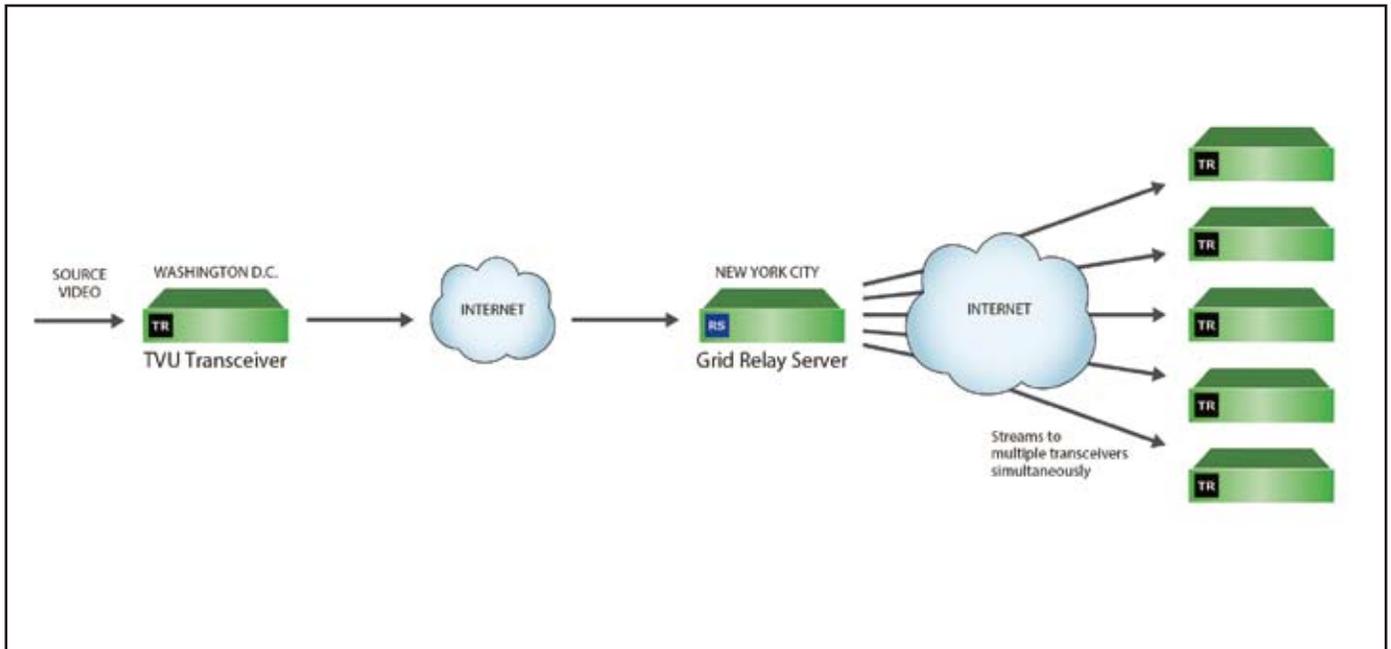
Use Case Four: Point-to-Multiple-Point (With Grid Relay Server)

This configuration is designed for large broadcast organizations looking for a highly scalable solution capable of distributing video streams between a large number of stations in disparate geographical locations. Utilizing the Grid Relay Server, broadcast organizations can easily scale the Grid infrastructure to meet their needs, no matter how large, without heavily taxing the bandwidth requirements at each individual station.

Because this configuration uses the Grid Relay Server, the broadcaster must either host the physical appliance in their own data center or license a cloud instance of the server directly from TVU. Organizations that deploy the Relay Server in their own data center must ensure that the 8 Mb/s per stream bandwidth requirements are met in order to distribute HD video to each connected station on the Grid. In this configuration, the solution can scale easily as the only requirement to add more stations to the Grid is to deploy TVU Transceivers at each new station and connect them to the Grid Relay Server.

In the following diagram, a major network based in New York City has deployed Grid Transceivers in each of its 300 network affiliate locations across the United States to ensure that breaking news of national importance can be easily shared. In this example, breaking news in Washington D.C. is captured with a TVUPack in the field and streamed from the Transceiver at the station in Washington D.C. to the Relay Server sitting in the network’s data center in New York. The Relay Server then sends out simultaneous streams to 100 network affiliates across the country requesting the video through the Grid Switch interface.

In this example, the bandwidth requirements are significantly lower at each individual station, as they only require 8 Mb/s to pull down the incoming stream. At the data center, the Grid Relay would require 240 Mb/s of bandwidth to concurrently deliver 30 instances of the stream to each requesting station.



Conclusion

The move to IP is already underway as stations look to reduce complexity within their workflows and reduce the costs of delivering video to viewers and other stations. For broadcasters looking to share live content, TVU Grid delivers on the promise of IP – enabling broadcast stations to pull video content from any source and easily share it with other stations using the IP infrastructure that is already in place. TVU Grid is the first step for broadcasters to begin the move to a completely IP-based infrastructure.