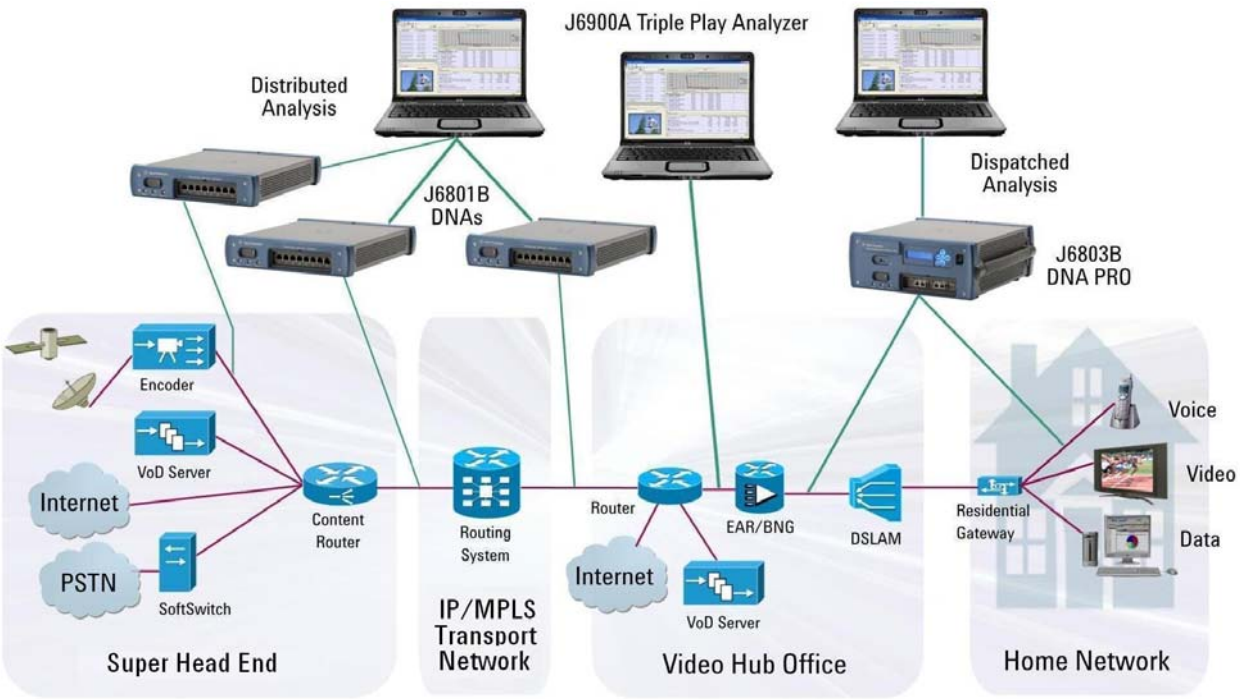
# Triple Play Network Analysis with the Agilent Technologies J6900A Triple Play Analyzer

Application Note




Agilent Technologies

## Introduction

Triple play networks comprise the convergence of video, voice, and data services over a single broadband connection. To satisfy the requirements of monitoring triple play networks, and ensure a high Quality of Experience (QoE) to consumers of triple play services, a leading-edge generation of highly-efficient protocol analyzers is required. Emerging among these test tools, the J6900A Agilent Triple Play Analyzer has proven to exceed these testing requirements. Testing all levels of the ISO model, the capability of the Agilent Triple Play Analyzer, with its all-in-one voice, video, and data monitoring ensures a high Quality of Service for providers, and ultimately a high Quality of Experience for consumers of triple play services.

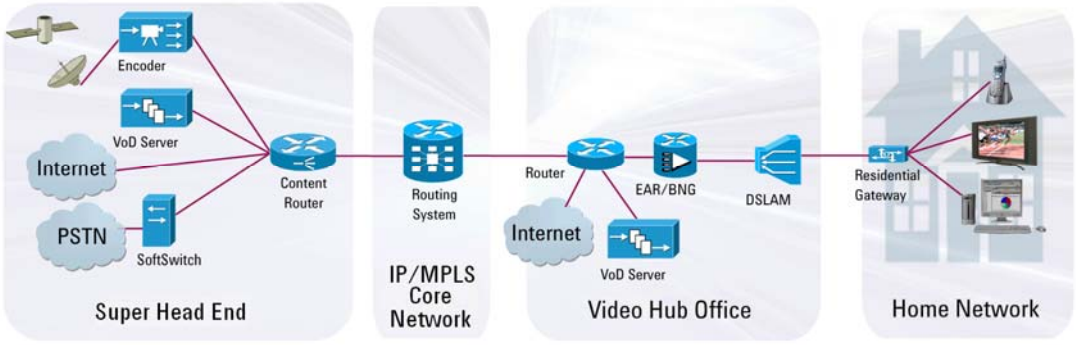
## Scope of this Document

This application note provides an overview of triple play network analysis and a case study showing how to assess the health of a triple play network using the Triple Play Analyzer.

The information presented here should be used in conjunction with the Triple Play Analyzer Quick Start instructions, Getting Started Guide, and online Help system. The Getting Started Guide provides installation and setup instructions for the hardware and software. The online Help system provides detailed procedures and reference information to assist in learning to use the Triple Play Analyzer.

## Overview of Triple Play Networks

Triple play networks deliver voice, video, and data media simultaneously to multiple subscribers. Delivering these converged voice, video, and data services (VoIP, VoD, and IPTV) is a complex distribution system in today's IP networks, as data types, loads, and access methods are increasing. As the growth of VoD increases, stress in the IP/MPLS transport network occurs as the load on bandwidth and throughput increases. As loads increase, service providers experience network congestion, and these problems are passed onto the DSLAMs and ultimately to consumers.




R&D development, system verification, deployment, monitoring, and troubleshooting management utilize the Triple Play Analyzer for all of these test needs, from the media source at the super head end to the consumer at home.

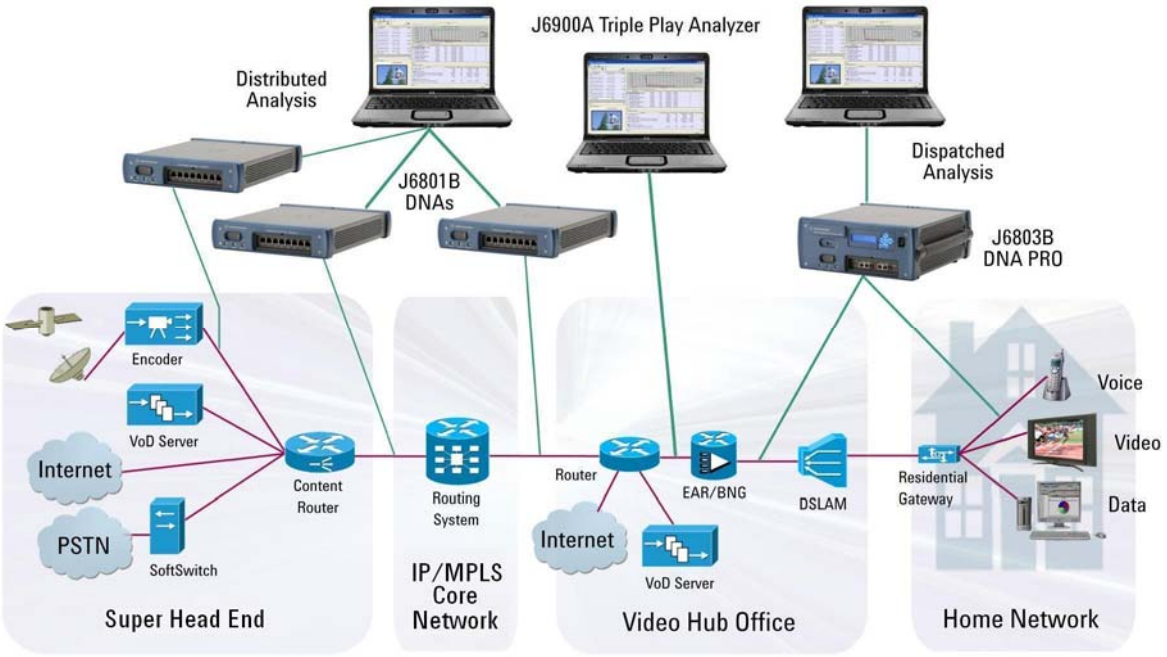
## Analyzing the Performance of Triple Play Networks

The Agilent Triple Play Analyzer evaluates the performance of triple play networks by calculating Quality of Service (QoS) and Quality of Experience (QoE) statistics for voice, video, and data analysis. In triple play networks, testing requirements must account for the performance and quality of voice, video, and data services, join and leave delays in channel surfing, functionality of unicast Video on Demand (VoD) streams and multicast streams for broadcast. Packet loss, jitter and delay, video signaling, user authentication, and accessibility are testing integrals.

The QoS for service providers, and QoE for consumers, are characterized by the perception of data transfer and timing from the service provider to the consumer. QoS is measured using the Media Data Index Delay Factor and Media Loss Rate. QoE is measured using the Video MOS rating.

The end-to-end quality of service for IPTV deployment involves the source of the VoIP, Internet, and IPTV feeds, through the IP network, to the set-top box (STB). The flow to the STB remains constant, while the content is switched according to the consumer's preference, resulting in a QoE based on the perception of quality output from the residential gateway.

An overview of an IPTV triple play network is shown in the following figure. Monitoring of the triple play services occurs at each major point. Critical statistics measurements are taken and analyzed at the encoder output, VoD server, EAR (Ethernet Aggregation Router), B-RAS, DSLAM, and the residential gateway output at the home network.




Service Provider use different teams to maintain different areas of the triple play network. During testing, the Service Provider must determine which point to test for each major area of the network.

For detailed network testing throughout various points in the network, the Triple Play Analyzer can be used with a NIC, or with the Agilent DNA or DNA PRO at the following locations:

- Super Head End (SHE) – Post Encoder, Pre/post A Server, Pre IP/MPLS Transport Network
- IP/MPLS Transport Network – Support for MPLS\GRE\VLAN, QoS
- Video Hub Office (VHO) – Post Encoder, Pre/post A Server, Pre/post D Server, IP Convergence
- Home Network – Post Residential Gateway

Several test point locations monitored by the Triple Play Analyzer for the scenario described in this document include the following.

**Super Head End (SHE)**

**Encoder Tests**:

Pattern/Bit Stuffing
PCR Jitter
CC Errors
MPEG2 Transport Stream
GOP Issues
Video MOS

**A Server Tests**:

Removal of Stuffing
RTP Sequencing
DRM
Server Performance
IP Jitter

**Video Hub Office (VHO)**

**Local Encoder Tests**:

Pattern/Bit Stuffing
PCR Jitter
CC Errors
MPEG2 Transport Stream
GOP Issues
Video MOS

**A Server Tests**:

Removal of Stuffing
RTP Sequencing
DRM
Server Performance
IP Jitter

**IP/MPLS Transport Network**

**Transport Network Tests**:

Media Delivery Index
RFC 3357 Loss Pattern Metrics
MPLS Routing and QoS
VLAN IDs and QoS
GRE Tunnels

**Home Network**

**Residential Gateway Tests**:

PCR Jitter (Lip-sync)
Data Issues
VoIP QoS Issues

STB Tests:

Zap Response
Zap Overrun, Underrun
Consistent Zap Response (QoE)

The Triple Play Analyzer supports the following signaling and control protocols: IGMP – Internet Group Management Protocol, RTSP – Real Time Streaming Protocol, SIP – Session Initiation Protocol, and the RTCP – Real Time Control Protocol. The analyzer calculates media stream QoS and QoE statistics carried over these protocol stacks: UDP/MPEG2-TS, UDP/RTP/MPEG2-TS, UDP/RTP/MPEG2-TS/MPEG PES, UDP/RTP, and TCP/RTSP/RTP.

In video and audio encoding standards for IPTV and digital multi-media applications, UDP is chosen because it is the simplest layer 4 protocol. It is used to encapsulate video because video over IP is consumed in real-time, regardless of the protocols used to encapsulate the payload.

Performance guidelines by standards bodies such as ETSI, ITU, the TeleManagememt Forum (an international consortium of communications service providers and suppliers) define and maintain specifications for the detailed technical aspects of the IPTV and triple play arena.

## Assessing the Health of an Operational Triple Play Network

The video MOS capability of the Triple Play Analyzer provides verification of the media quality to the consumer at the application layer. Real-time RTP performance analysis is performed at the session layer. At the network, transport, and session layers, real-time transport metrics and their effect on QoE are calculated. Real-time analysis of protocols and technologies are calculated at the physical, data link, network, and transport layers.

To analyze signaling performance, the IPTV and VoD signaling analysis includes channel zap times, and ICC and RTSP signaling for each channel or subscriber. Protocol analysis, filtering, and decodes including IPTV and MSTV, determine root causes.

How to assess a typical triple play network follows, demonstrating how to set up and use the Triple Play Analyzer to examine detailed voice, video, data, and signaling statistics of a service provider's triple play network.

### Analysis and Troubleshooting Scenario

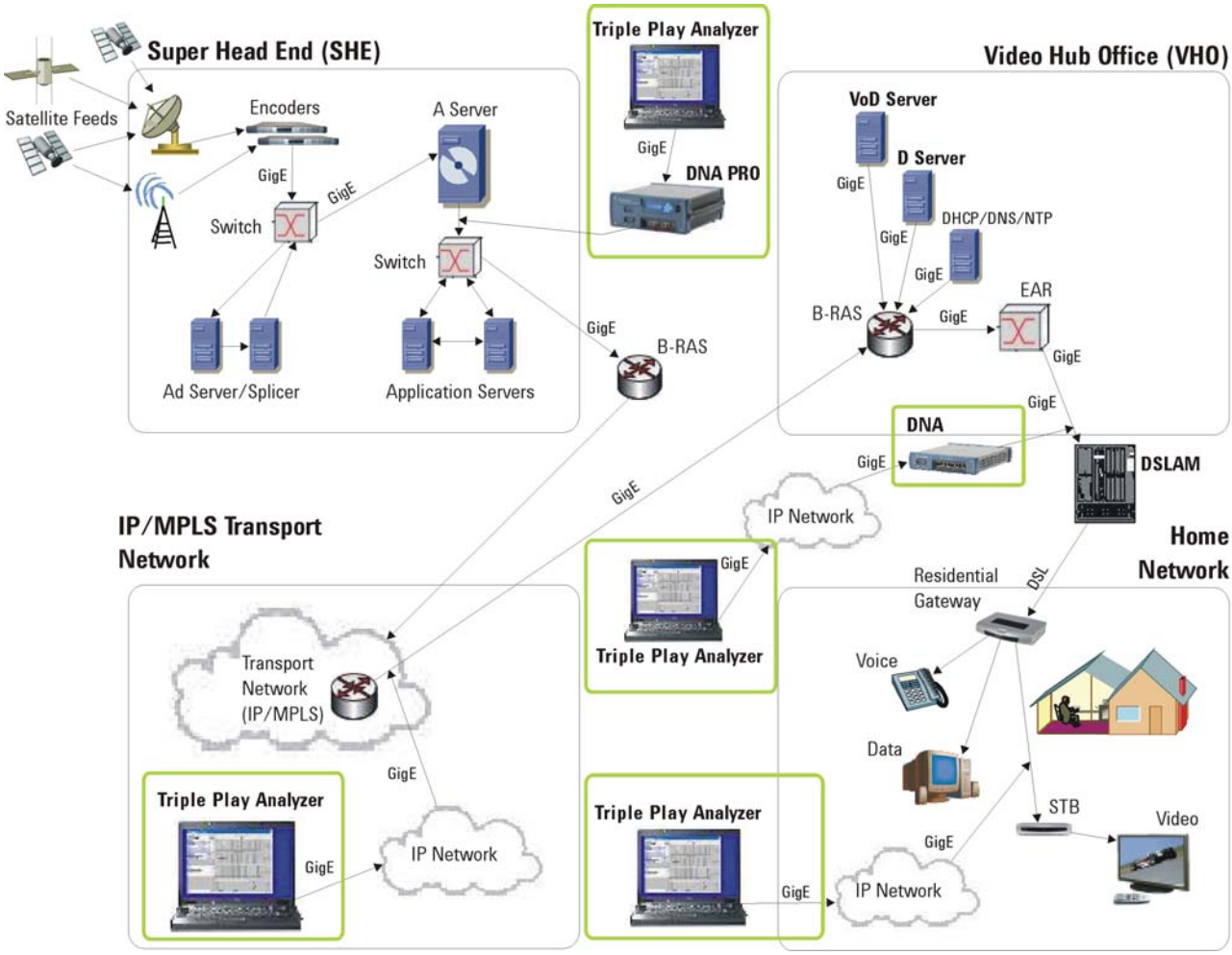
A major service provider is contracted with a content provider to receive video and audio content for its triple play IPTV services. The content provider distributes video and audio content to the service provider's video hub office and the access provider's network in the form of broadcast TV. The triple play content is sent over an IP-based wireline network to the consumer's home network, as shown in the following diagram.

Residential and enterprise customers are complaining of poor video quality and variable response in channel change on their set-top boxes, slow response times on their PCs, and noise in telephone conversations.

The content provider confirms a good GOP pattern is being sent, but some errors are occurring throughout the network. The service provider is validating a loss of video packets, PCR jitter, continuity count errors, out-of-sequence errors, MDI-DF and MDI-MLR, and unacceptable ZAP times. Although the GOP pattern indicates that the encoder at the content provider's video hub office is sending the correct data, problems at the local encoder in the video hub office may be occurring, including CC (continuity count) errors and jitter.

The IP/MPLS transport network may also be experiencing problems in handling and routing the packet stream, and the access network could be experiencing problems at the edge router or DSLAMs, causing problems in the shared triple play services at the home network.

The connection solution for the Triple Play Analyzer to the IPTV network is multi-faceted, depending on the network configuration requirements – to the Gigabit Ethernet interface over the PCI-E NIC in the PC, to a DNA, or to a DNA PRO.




To monitor and verify the quality of the media through the transport service, and locate the source of problems, the Triple Play Analyzer will be employed at various points in the network, using different data acquisition systems – the Agilent DNA PRO, DNA, and PCI-E NIC. The Triple Play Analyzers are connected at the following locations.

- Super head end encoder output – to monitor the GOP pattern, Video MOS, MPEG-TS, PCR Jitter, PSI Rate, and other statistics.
- IP/MPLS transport network core router output – to monitor the quality of content from the service provider network to verify that the network access quality is acceptable to customers.
- Video hub office encoder output – to monitor the quality of the content being generated from the content provider according to the service-level agreement between the service provider and the content provider.
- DSLAM input – to monitor and verify the quality from the access network to the edge of the home network.
- Residential gateway output – to verify the end user's quality of experience (QoE) at the home network.

## Overview of the Testing Process

To assess the IPTV/MSTV triple play network, the testing process requires these steps:

1. Install and license the Triple Play Analyzer software.

2. Connect the PC NIC to the IP network under test.

3. Start and configure the Triple Play Analyzer.

4. Set thresholds, events, and alarms.

5. Start a real-time data run.

6. Assess the network performance, locate problem areas, and analyze the measurement statistics.

These steps are described in the following sections. The procedures presented are for specific testing purposes, and may differ from your test and troubleshooting scenarios.

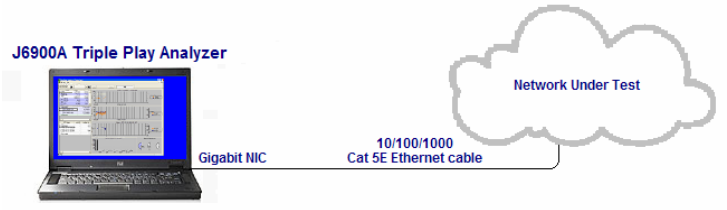
The analyzer ships with supporting documents to help you set up and use the Triple Play Analyzer in your troubleshooting scenarios, including Quick Start Instructions, a Getting Started Guide, and online Help.

## Install and License the Software

The Triple Play Analyzer uses fixed, flexible licenses, which must be redeemed from the Agilent software licensing web site before using the software. After redeeming the flexible licenses, use the Agilent Triple Play Analyzer CD to install the software on a Windows® PC.

## Connect to the IP Network Under Test

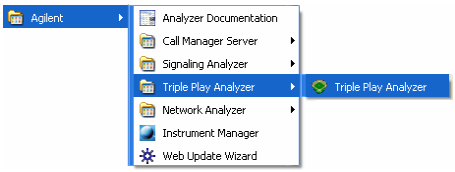
The Triple Play Analyzer is installed on a PC that is running Windows® XP Professional, has an Intel® Core™ Duo processor, 2.0 GHz, and 2 GB RAM. The PC connects to the IP network under test using a PCI-E Gigabit NIC.



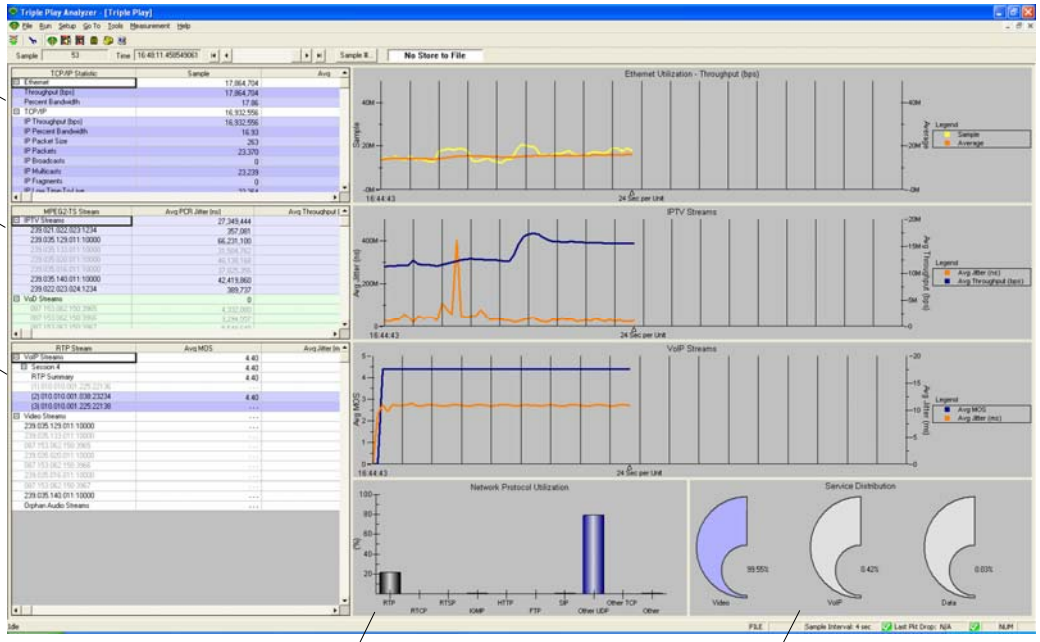

The Triple Play Analyzer can be used with the J6801B DNA or the J6803A/B DNA PRO to monitor Ethernet interfaces, as described later.

## Start and Configure the Triple Play Analyzer

Start the Triple Play Analyzer.



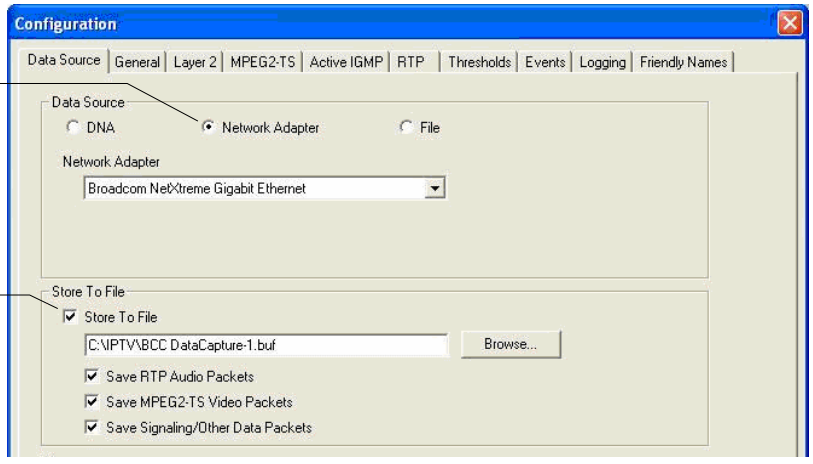
The Triple Play measurement view appears, as shown here.




### Configure the Data Source

The Triple Play Analyzer can connect to the IP network under test using an Agilent DNA or DNA PRO, or a NIC for the Ethernet connection. In parts of this scenario, the Triple Play Analyzer is monitoring the network over the PCI-E Gigabit NIC.

Use the  Configuration button to configure the Triple Play Analyzer for the test setup in this scenario. Configure the Triple Play Analyzer to store the audio, video, and network data to a file, as shown here.



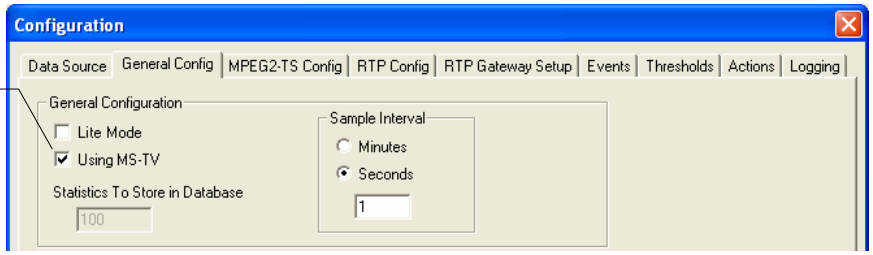

Select the Network Adapter to connect to the network under test using the PC NIC.

Select the packet types to store to a data file.

### Configure the Acquisition Mode

Set the mode to MS-TV so that the analyzer can measure the MSTV Instant Channel Change (ICC) zap time. If you wanted to monitor a few VoIP and Video streams only, you would select Lite mode.

Set the Configuration mode to Using MS-TV and the sample interval to one second.

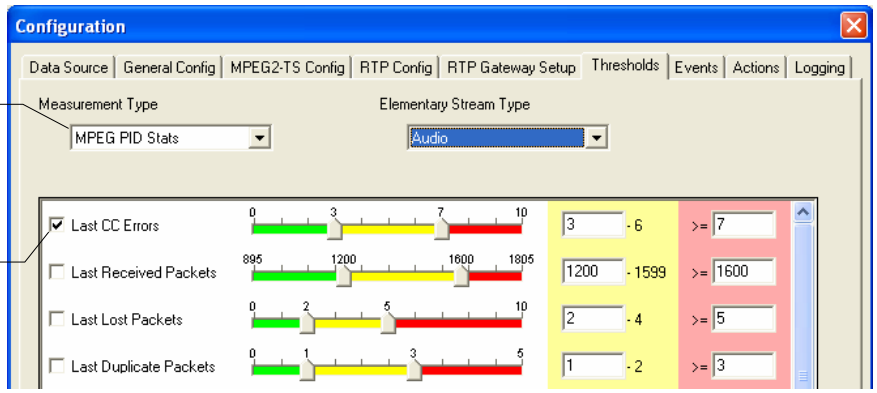



### Configure the MPEG PID Audio Thresholds

For the analyzer to report errors in Continuity Count, set the CC error thresholds to be flagged when they exceed a value of 4. Cautionary threshold values between 3 and 7 will be flagged and alerted to the Service Provider after an action is set on the threshold.

Continuity Count errors are part of the MPEG PID statistics.

Set the MPEG PID Statistics measurement to find CC errors in the audio elementary stream.

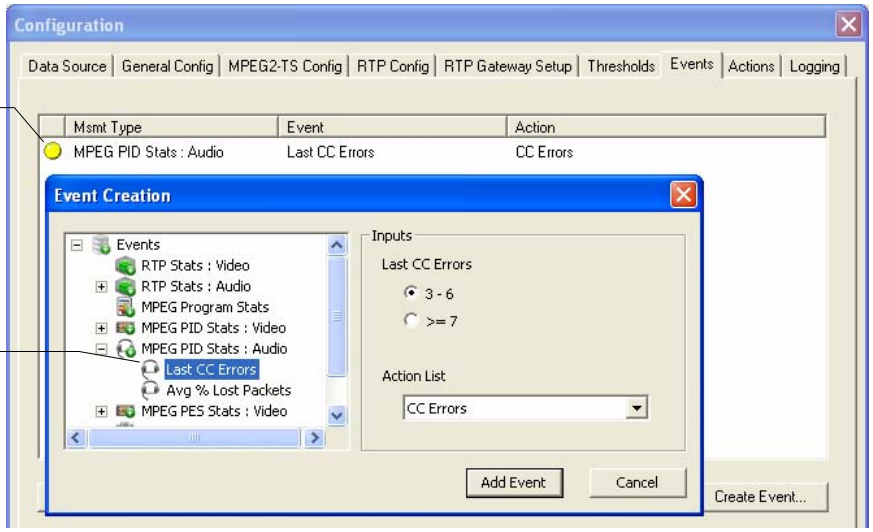



### Set the Threshold Event

To notify the Service Provider to potential network problems as a result of CC errors, set an event and action to be taken when the thresholds are exceeded.

The yellow cautionary threshold is defined for the audio elementary stream.

Define the event to take place when the threshold is exceeded.



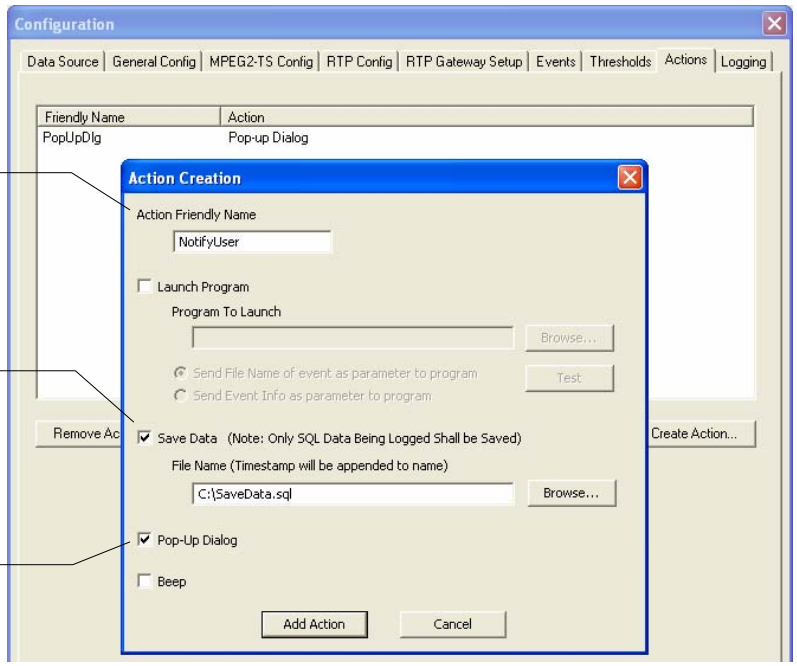
### Set the Action for the Exceeded Thresholds

As the analyzer monitors the network, a notification dialog box will pop up when the threshold is exceeded.

Define and name an action for the analyzer to take when the threshold is exceeded.

Store the data that has been saved in the database when the threshold is exceeded.

Request the analyzer to pop up a notification message.



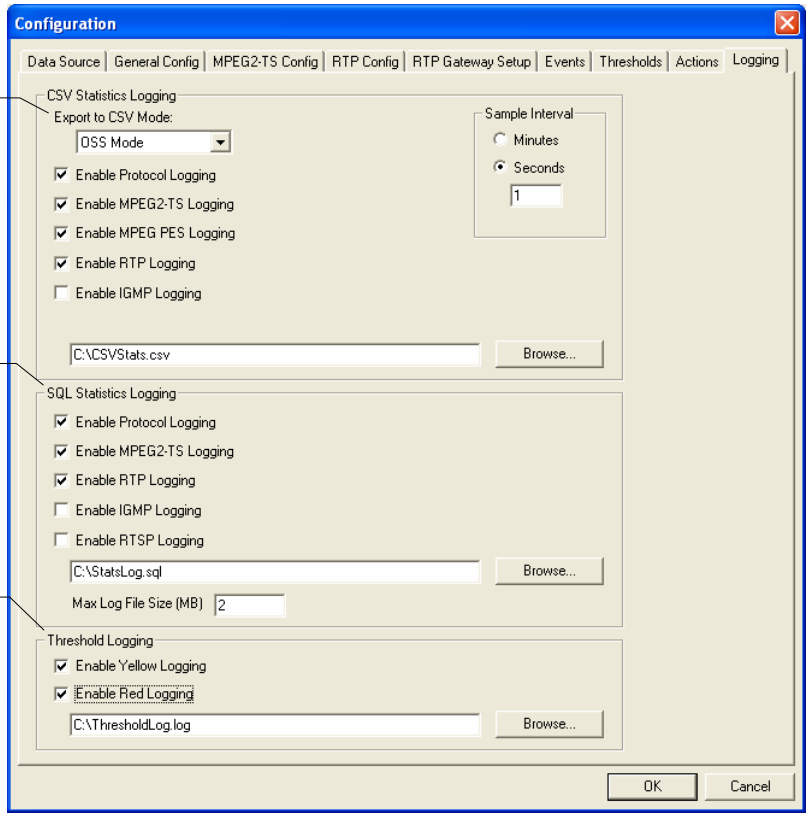

### Logging Data

Save the measurement statistics and threshold data.

Choose OSS Mode, mark the statistics to save, and specify a name for the CSV statistics log file.

Choose the Protocol Statistics to save, and specify a name for the SQL statistics database log file.

Choose the thresholds to save, and specify a name for the thresholds log file.



### Start a Real-Time Data Run

Use the  Start Run button to begin capturing data real-time.

The analyzer calculates values for every measurement statistic. These values are identical, regardless of whether the analyzer analyzes the incoming data using a PCI-E NIC, or the data is streamed from a Multi-User Server with a DNA or DNA PRO.

### Begin Assessing the Triple Play Network Performance

The Triple Play Analyzer provides measurement views to assess each critical test point in the network, from the customer's experience network at the application layer to the physical data transport at the lower layers.

Use the Triple Play view to display a high-level overview of the QoS for the voice, video, and data triple play services. Examine network utilization, protocol utilization, distribution, MPEG2-TS video streams with user-defined measurements, and all RTP streams for VoIP and video.

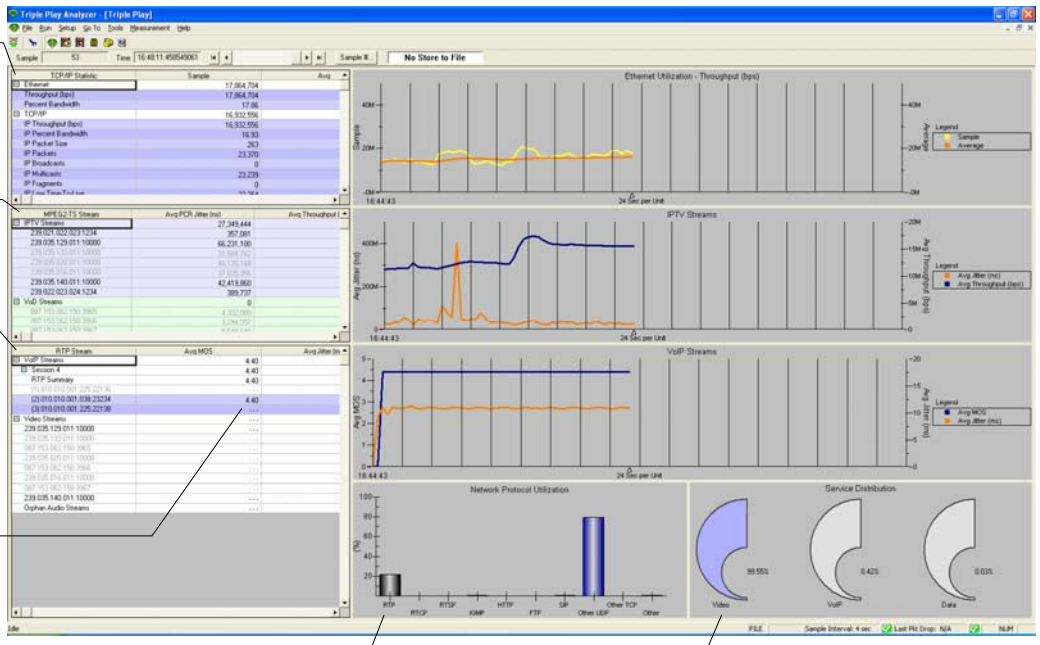
Use the right-click menu items to select the measurement statistics.

Ethernet and TCP/IP throughput and samples are calculated and graphed.

IPTV and VoD Streams are graphed for each IP address.

MOS for RTP VoIP, Video, and Orphan streams are calculated and graphed.

An audio MOS rating between 4 and 5 is a good score, providing acceptable QoS.



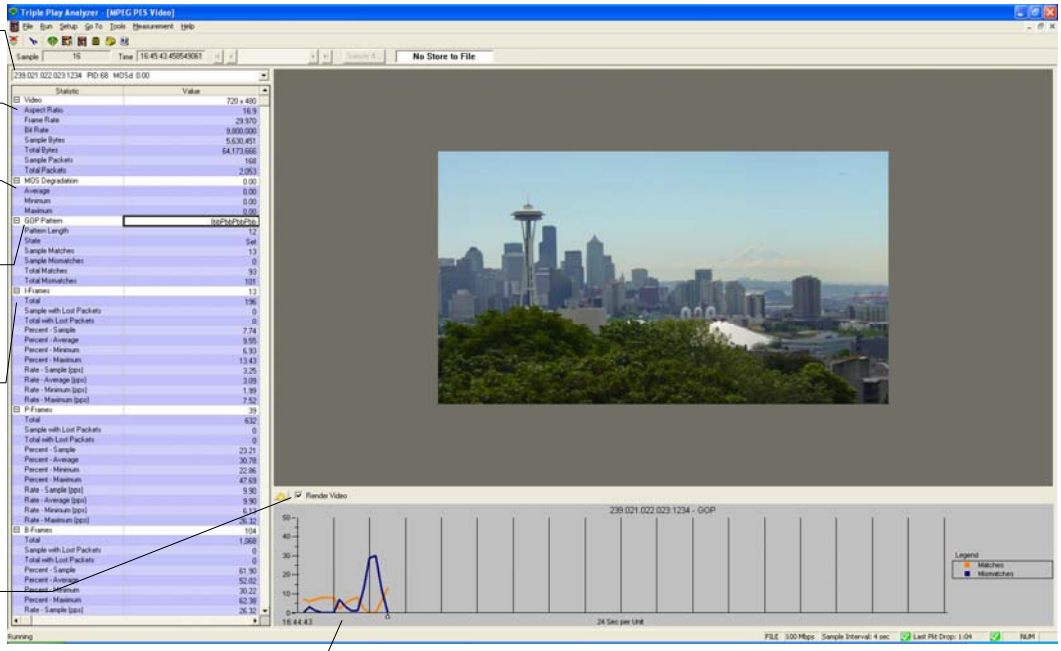
RTP and UDP protocols are utilized for the media transport.

Video transport is consuming most of the resources.

Although the Triple Play view reveals that the video is being transported through the network, it is necessary to analyze the media transport through the network in greater detail. The next step is to assess the quality of the video in the MPEG PES Statistics view to verify whether the customer quality of experience is acceptable.

### Analyze Quality of Experience

Use the MPEG PES view to assess the customer's quality of experience (QoE). Render the video in its native aspect ratio to view the impact of the network performance on the video being transported through the network.




Depending on the assessment of QoE, and the MOS degradation, the next step is to investigate QoS problems in the transport network using the MPEG2-TS Statistics view.

### Analyze Quality of Service

Use the MPEG2-TS Statistics view to assess the network's quality of service (QoS). For IPTV and VoD streams over the MPEG2-TS protocol, the MDI results reveal the QoS.

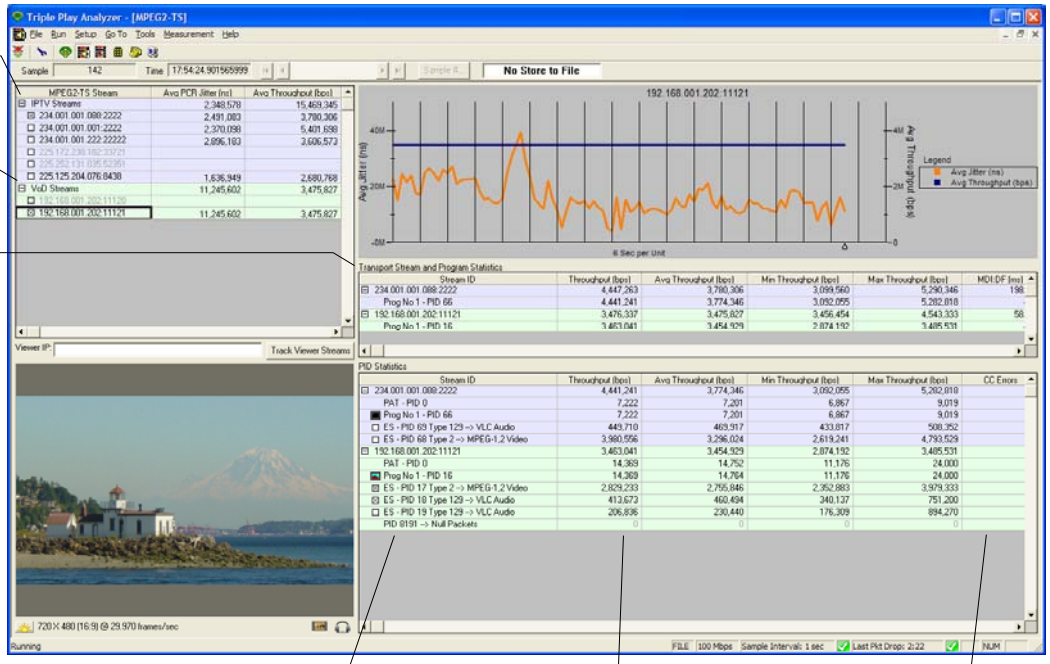
The MPEG2-TS Statistics view calculates the following statistics:

- ETSI TR 101 290 Events – Digital Video Broadcasting (DVB) Measurement Guidelines for DVB Systems
- Errors Per PID – Errors per part of the stream
- Transport Stream Errors
- Throughput per PID
- Spurious PID information for PIDs that are not part of the video stream
- PCR Values – To determine if the encoder is falling behind
- Rendering of Video and Audio per multicast for immediate viewing by users

IPTV streams are recognized by the analyzer.

VoD streams are recognized.

Transport Stream Statistics – with ETSI TR 101 290 Events – are calculated for every selected stream.




Spurious PIDs that arrive appear in the Stream ID column.

Calculations for each program, ES, and PID.

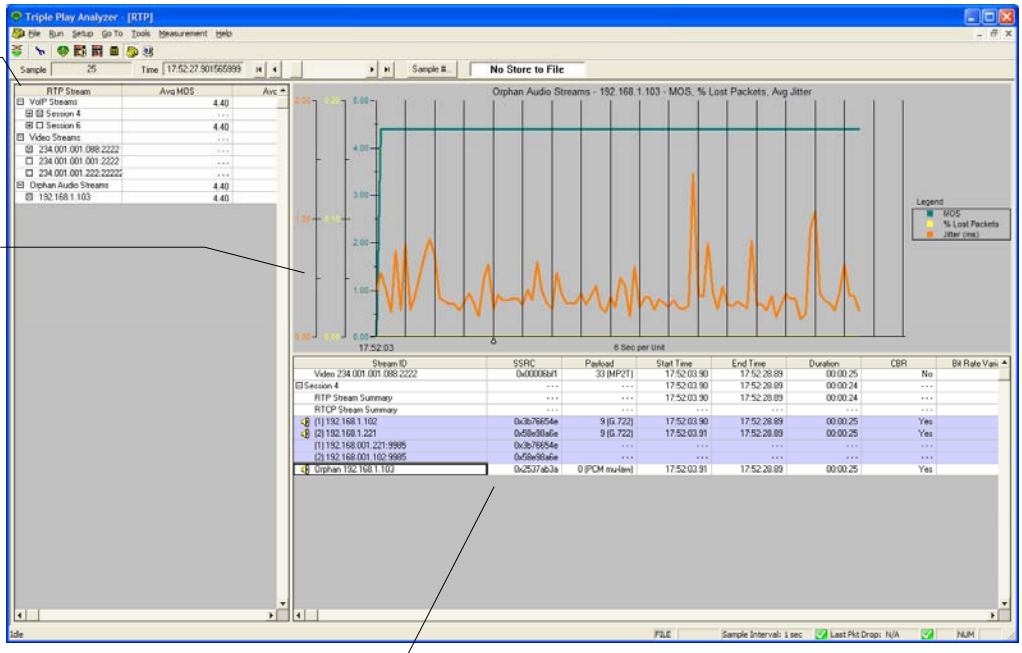
Transport Stream error statistics begin here.

### Analyze VoIP and Video over RTP

After verifying the video quality, use the RTP Statistics view to display the VoIP and video streams carried over the RTP protocol, and play the audio streams. At this point is important to view any Lost Packets, the MDI for RTP, Loss Distance, Loss Length, Distance between Losses (Holes), VoIP MOS, and VoIP R-Factor, among other statistics.

VoIP and Video streams, carried over RTP, are recognized by the analyzer.

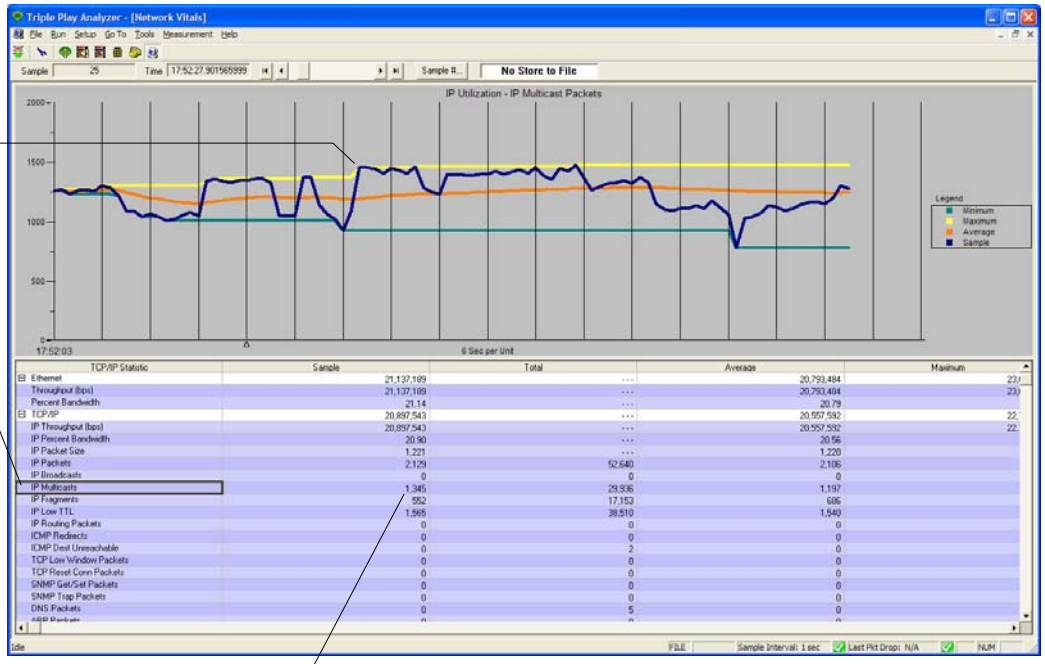
VoIP MOS, lost packets, and jitter correspond to the calculated values of the stream selected below.




The analyzer calculates real-time statistics for each known VoIP and Video stream.

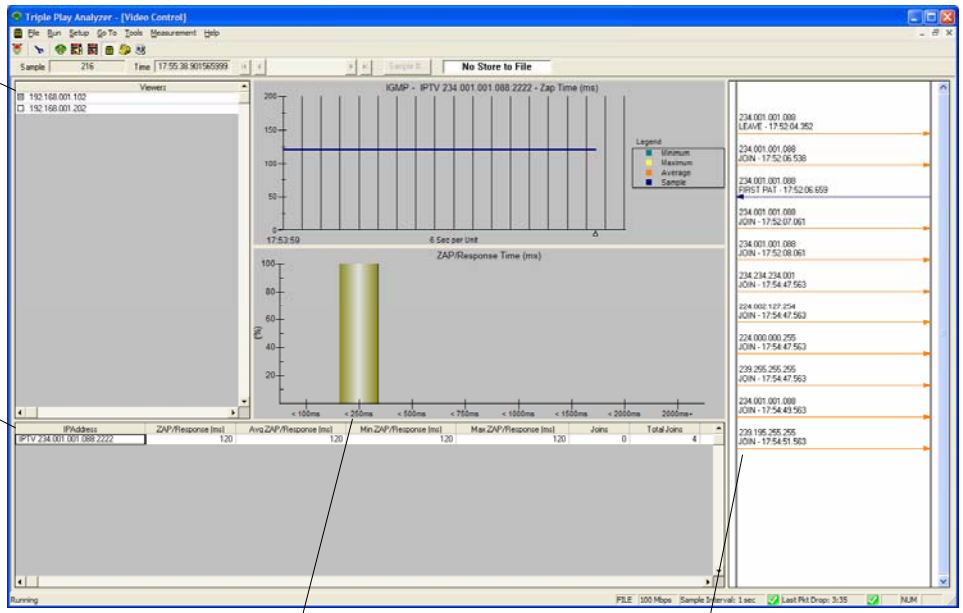
### Confirm the Throughput and Bandwidth

Assess the physical layer using the Network Vitals view, and confirm whether the media is reaching its destination by examining the Ethernet throughput and bandwidth, and TCP/IP statistics for the media transport.




### Examine the Video Control Signaling and Response Times

Use the Video Control view to examine IGMP/ICC signaling and channel zap times, and RTSP signaling and command response times. View the histogram for a quick glance of any variability in the channel zap times experienced by the individual viewer.



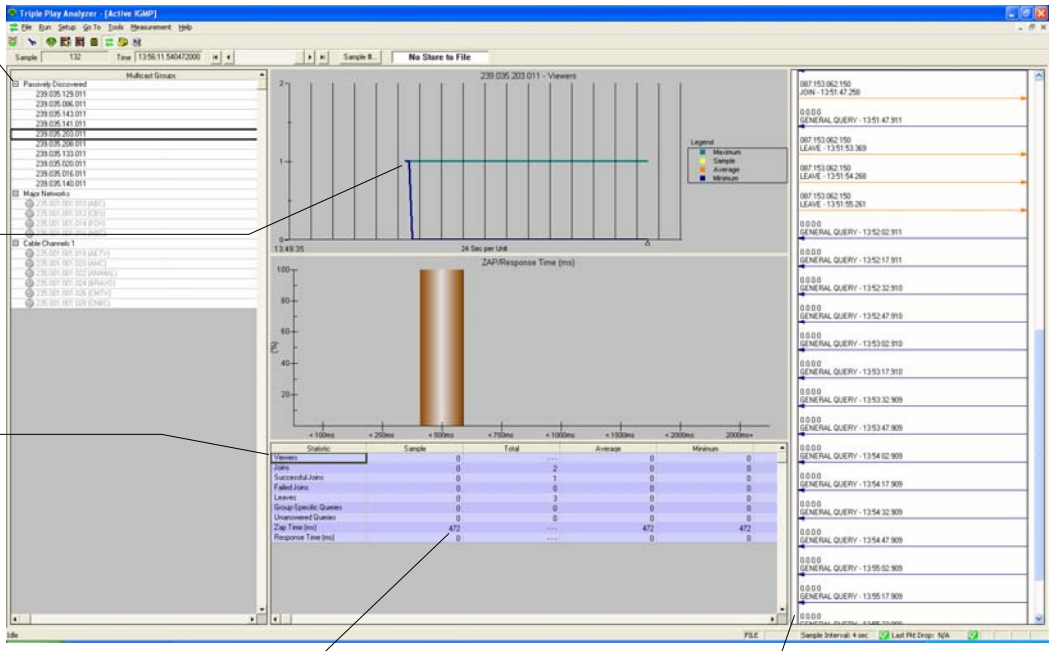
### Examine IGMP Multicast Group Interactions and Durations

Use the Active IGMP measurement to analyze the communication between an IGMP host, the multicast routers, and multicast source hosts in a group. You can track when an IGMP host joins a multicast group, view the queries from a multicast router to the IGMP host, and see the IGMP host's responses to the queries, which reveal the active viewers in each multicast group. IGMP versions 2 and 3 are supported.

Active multicast groups are discovered automatically.

Dramatic reduction in the number of viewers occurs in this sample multicast group.

Statistics are calculated in real time for the selected IGMP multicast group.



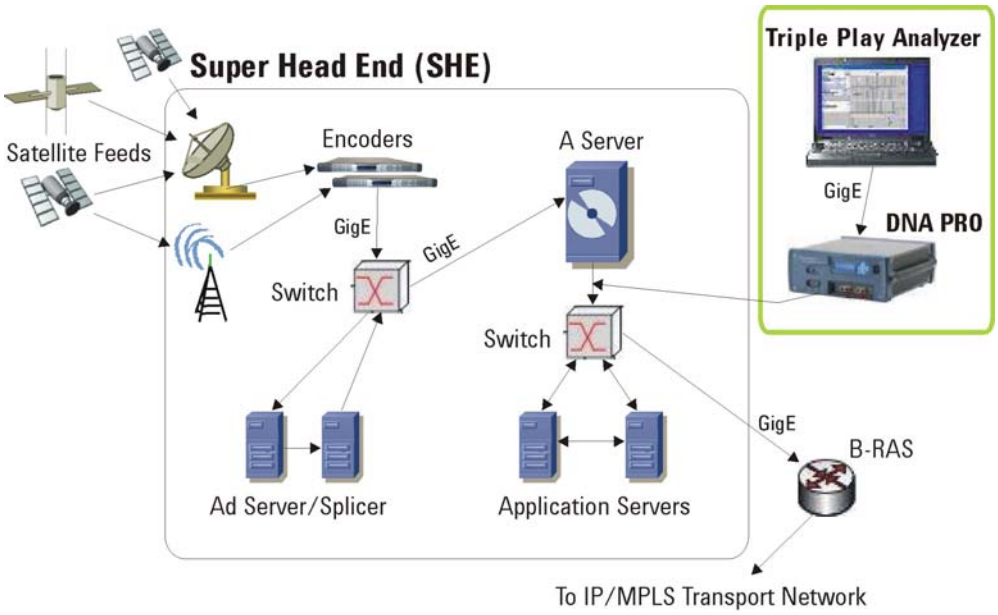
The Multicast zap time is 472 ms.

Use the histogram to see the viewers who join or leave a multicast group, along with queries from the IGMP multicast routers. Reported RTSP commands include play, pause, fast forward, rewind, and stop.

To assess the triple play network and troubleshoot QoS and QoE problems, it is always good practice to begin testing at the Super Head End (SHE) Encoder output, as this Encoder generates a Program Clock Reference (PCR) for each transport stream. During the network assessment, the Service Provider works with the teams responsible for the major areas of the network, from the SHE, to the IP/MPLS Transport Network, to the Video Hub Office (VHO), and the Home Network. Several significant problems are encountered in this scenario.

### Assess the PCR Jitter at the SHE Encoder Output

The SHE converts the satellite feed into an MPEG transport stream, which includes video and audio in multiple languages. The SHE Encoder sets the PCR for the stream, which provides the timing for the MPEG transport stream. The Encoder also generates the GOP pattern of I, P, and B frames for the video, and the Picture in Picture (PIP). To verify whether the Encoder is sending the correct data, the Triple Play Analyzer monitors the Encoder output and reports statistics on the transport stream.

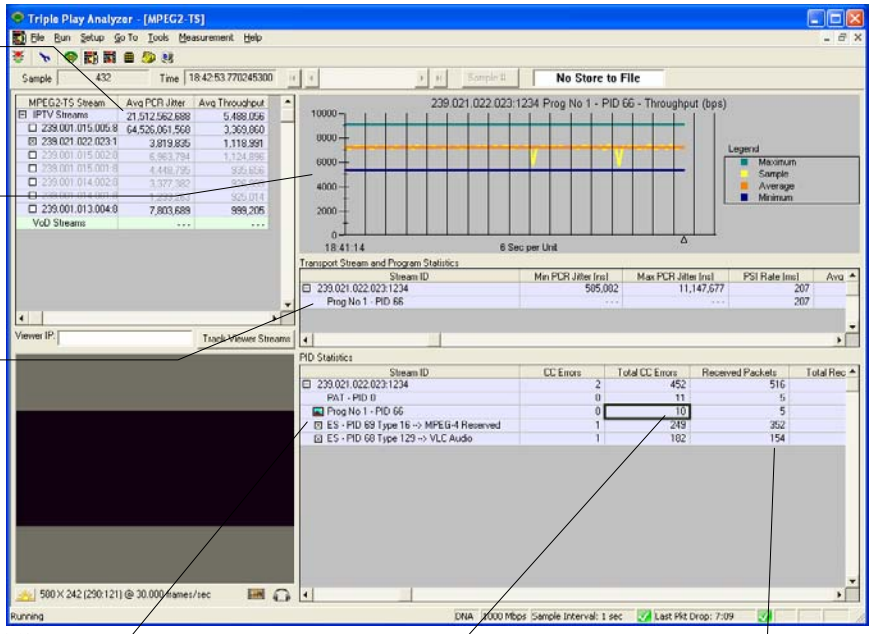



As shown in the following MPEG2-TS view, the IPTV streams are experiencing excessive amounts of PCR Jitter. When PCR Jitter occurs at the Encoder, it affects the synchronization of the audio and video in the MPEG transport stream.

PCR Jitter is occurring at the SHE encoder output, and is adversely affecting the MPEG2-TS streams.

The throughput for the selected IP address shows that the data is being transported through the network.

ETSI TR 101 290 events show adherence to requirements for DVB. Here, the PCR jitter values are not acceptable.




Although the elementary streams are marked and the viewer is enabled, the video will not render due to the jitter. Lip sync problems are also revealed when listening to the audio.

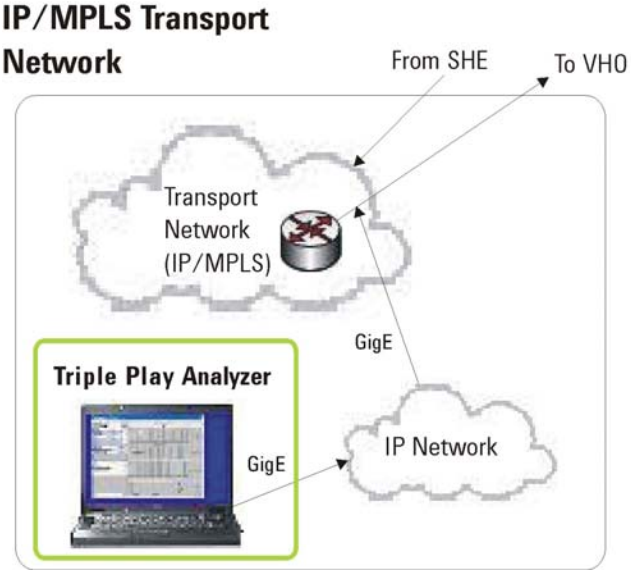
Continuity Count errors are occurring on the network.

Audio and video packets are being received, but the quality may be compromised.

The Service Provider must communicate the excessive PCR Jitter to the Content Provider to resolve the problem.

### Measure the Media Delivery Index in Delay Factor and Loss Rate

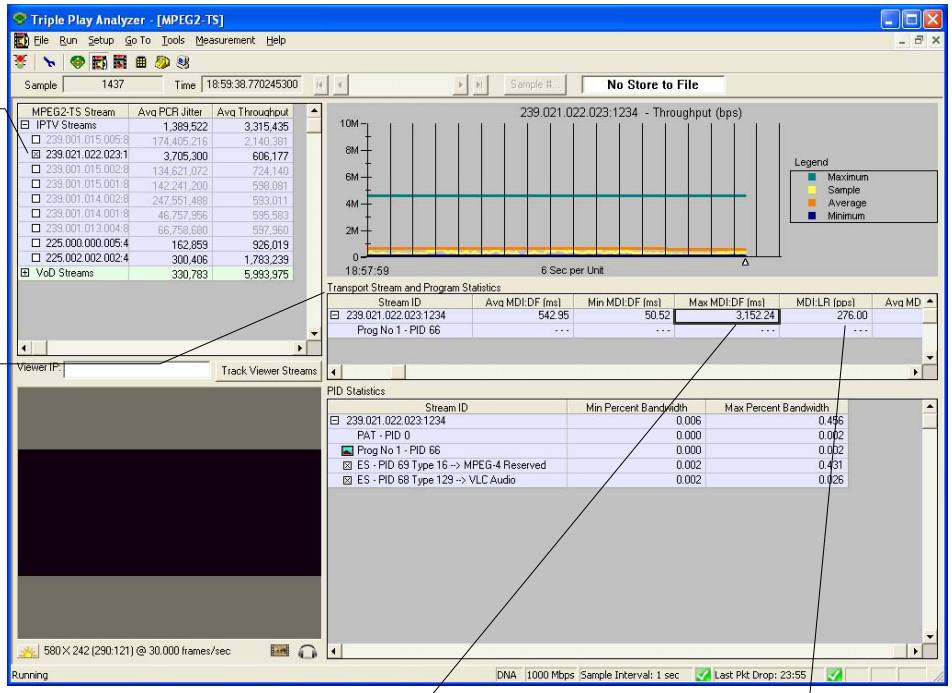
In the IP/MPLS transport network, QoS of the triple play network is measured by the Media Delivery Index (MDI), which includes two measurement components for the Delay Factor (DF) and the Loss Rate (LR). The DF measures variances of the inter-arrival time of IP packets. The LR measures the number of packets lost in the transport stream over a specific period of time.



MDI-DF and MDI-LR measurements are calculated and displayed in the MPEG2-TS view. During these measurements, notice that the delay factor in the transport stream is approximately 3 seconds. Using the MDI-DF calculation, the Service Provider can estimate that the network element buffer must be large enough to account for 3 to 4 seconds of data.

The analyzer calculates statistics for all active IPTV and VoD streams. Actual counts appear in the statistics tables.

ETSI TR 101 290 statistics reveal the adherence of the transport network to the guidelines defined for DVB systems.



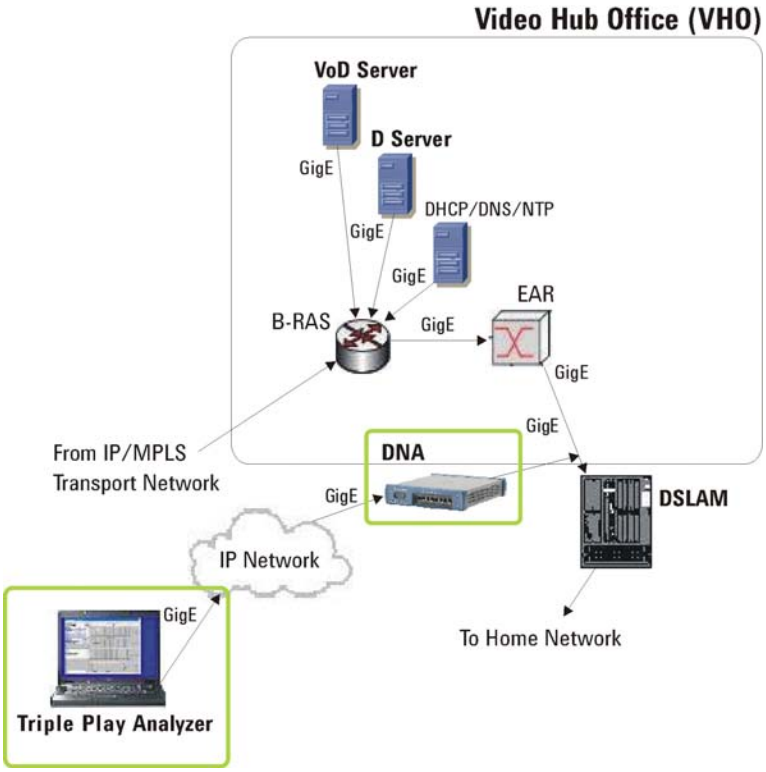

The DF component of MDI reveals delay in the transport stream.

The LF component of MDI reveals data loss in the transport stream.

As part of ensuring end users with a high QoE, the MDI Delay Factor is accounted for by the buffer in the network element. However, the MDI Loss Rate is not acceptable, as it can render poor quality in the video.

### Monitor the GOP Pattern and I, B, P Frame Lost Packets

In the VHO, the analyzer monitors the MPEG GOP frame pattern to ensure that the encoder is sending the correct frame pattern.



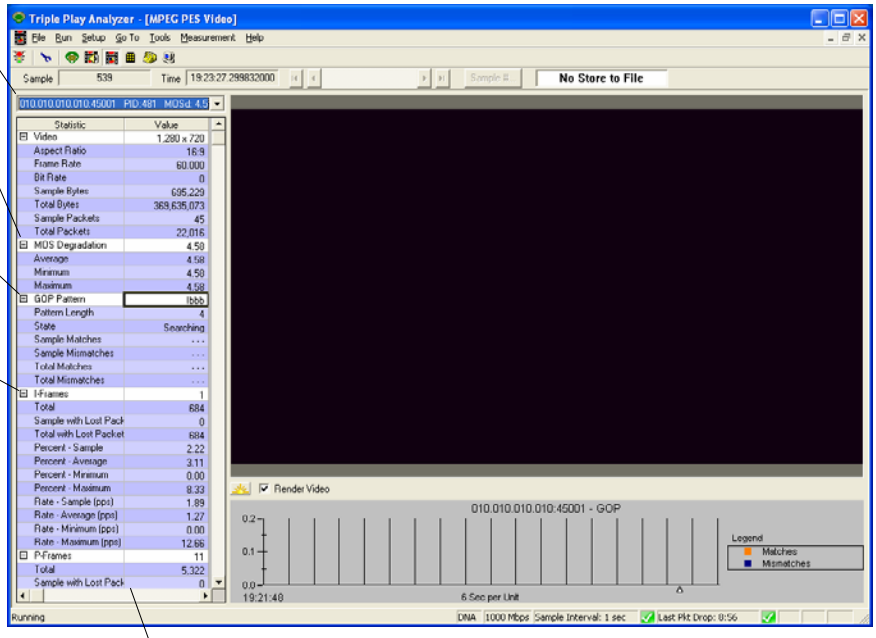

The analyzer monitors the frame statistics to determine if packets are lost during the video transport.

The selected viewer's video statistics appear below.

The MOS degradation (MOSd) values show the drop in Video MOS since the start of the transport.

The GOP pattern confirms that the video sent from the SHE encoder is correct.

This "I" frame has not lost any video packets. Because the "I" frames comprise the primary images in the video, a loss of "I" frames can reveal major dropouts in the video stream.



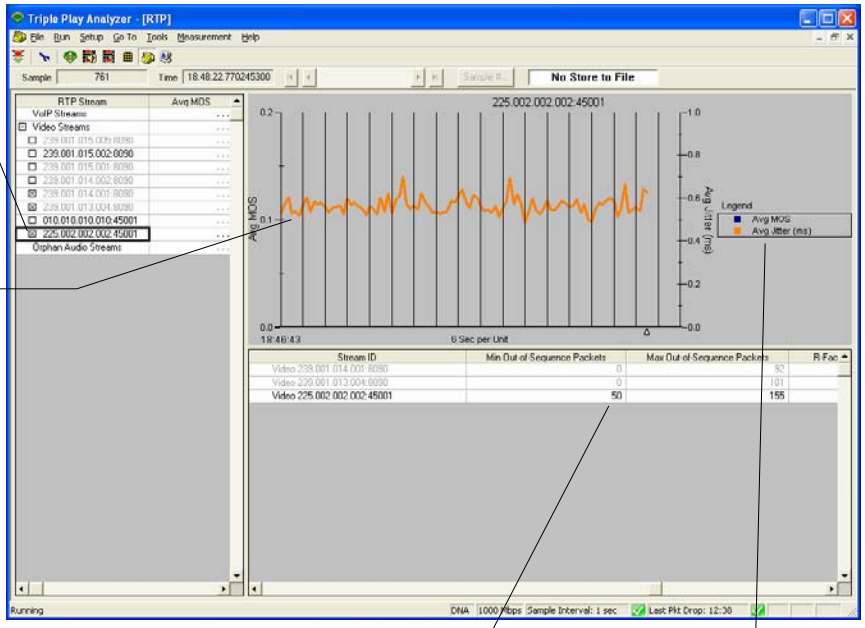

Even if the "I" frames are intact, packet losses can occur in the major predictive "P" frames and the bidirectional "B" frames, and these losses can impact the quality of the video.

### Measure Out of Sequence RTP Packets

When an RTP video stream is interrupted by jitter, packets in that stream can be forced out of sequence, which can degrade the video quality.

Examine jitter for the active video stream. Inactive video streams drop out of the list.

Jitter is occurring on the selected active video RTP stream, causing the real-time transport of the video to experience problems with frame sequencing.

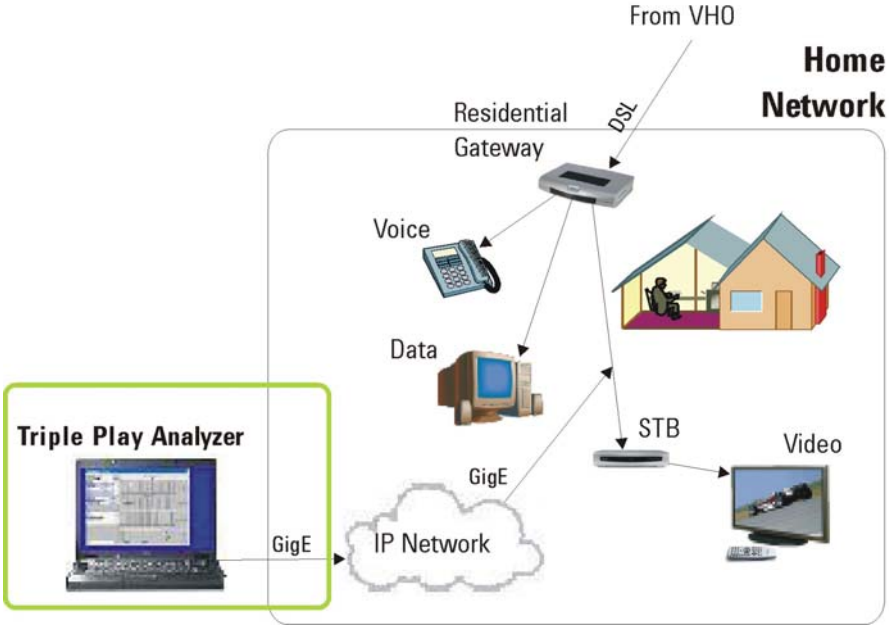



Sequencing problems are revealed by the Min and Max Out-of-Sequence values. The loss parameter (hole size, duration, and distance) is measured according to RFC 3357, and determines the performance of real-time packet voice and video applications.

RTP MOS is used for VoIP streams only.

### Measure Max Zap Times

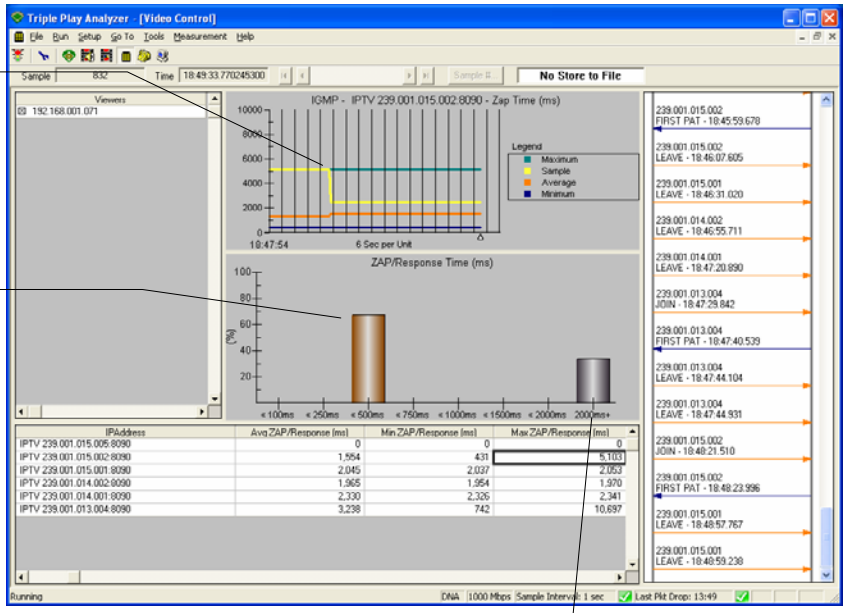
At the home network, the analyzer monitors IGMP/ICC signaling and channel zap times.




The analyzer measures a user's experience in channel zapping (changing of channels) at the set-top box (STB).

IGMP zap times are above normal up to this point, and then drop off.

The customer at the selected IP address is experiencing some variability in channel changing times, from 500 ms (which is acceptable) to 2 seconds (which is unacceptable).



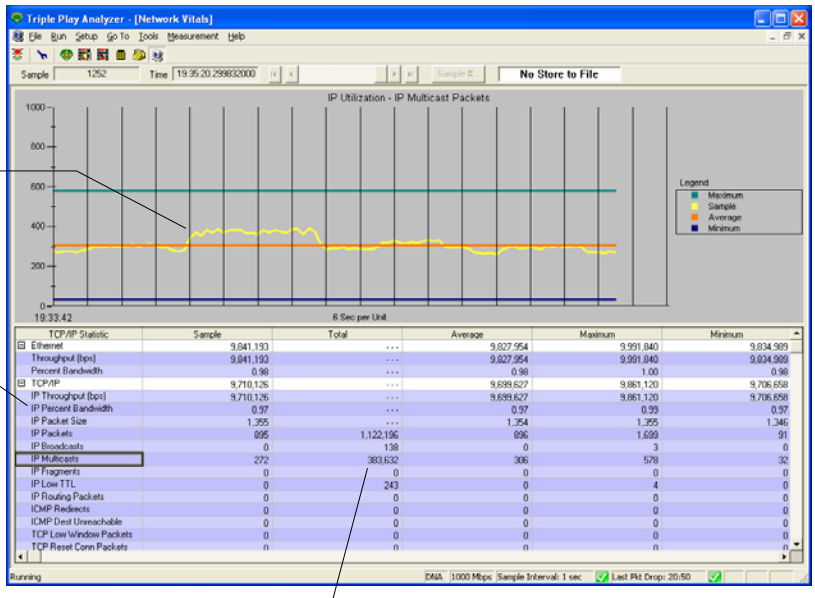

An unacceptable zap response time of 2 seconds is the type of delay that can cause viewers to complain to their service providers.

## Monitor IP Multicast Utilization

IP Multicast is used to send data to multiple recipients simultaneously. When a customer changes channels to join an IPTV program, an IGMP join request is sent to a multicast replicator, which sends the IP multicast video stream over UDP to the customer's STB. The Triple Play view shown earlier confirmed that the UDP protocol is being used.

The number of multicast packets sent in the MPEG2-TS streams over TCP/IP is average or above, indicating the IP multicast routing through the network is acceptable.

By delivering a single stream of audio and video to multiple recipients simultaneously, network traffic is reduced, causing the network bandwidth to be used efficiently.




The analyzer calculates the actual number of multicast packets making it through the network.

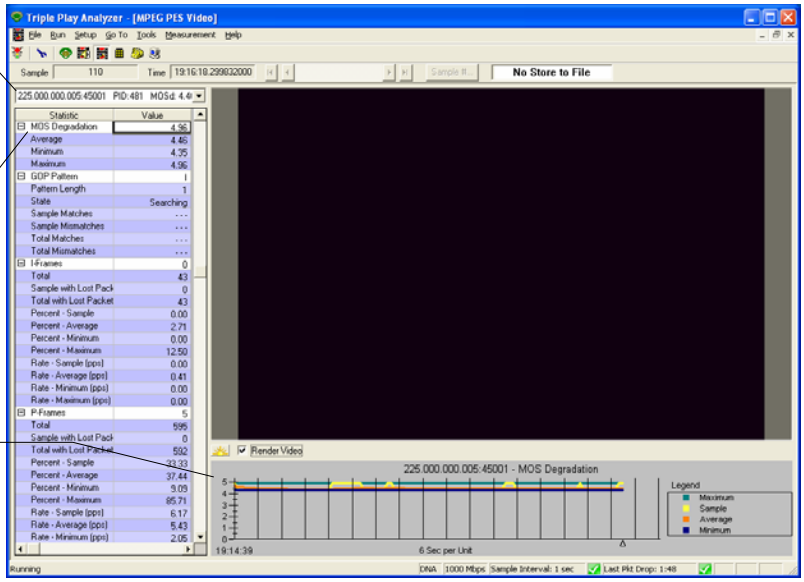
### Assess the Video MOS Degradation for a Stream

The MOS degradation performance metric, which is calculated on a scale of 1 to 5, measures the impact of the transport network performance on the video content.

The analyzer calculates Video MOS for the selected video stream.

Detailed MOSd values for the stream reveal a high degradation in MOS, meaning poor quality in the video, or no video at all if the MOSd value is excessive. Acceptable values depend on the network design.

The graph of MOS degradation reveals consistently high MOSd values. This analysis indicates fundamental problems such as congestion in the transport network.

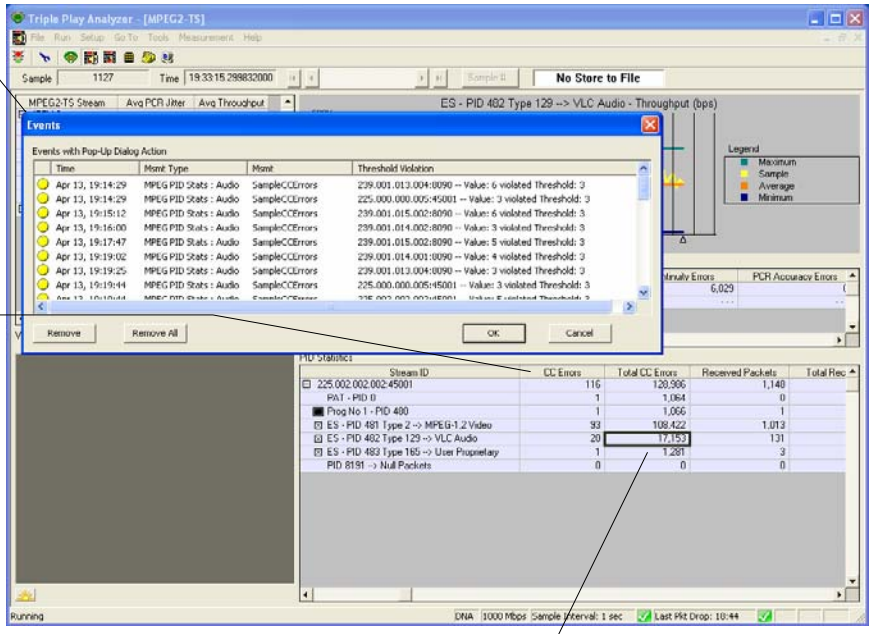



### Examine Continuity Count Errors, with Thresholds Exceeded

As shown earlier, when assessing the PCR jitter at the SHE Encoder output, Continuity Count (CC) errors were beginning to occur.

CC errors have exceeded the set thresholds, and the analyzer is reporting event notifications.

About 10 percent of the received packets have experienced CC errors. These errors indicate differences between the data in the packets sent and the packets received for each PID, which is compromising the quality of the transport stream.



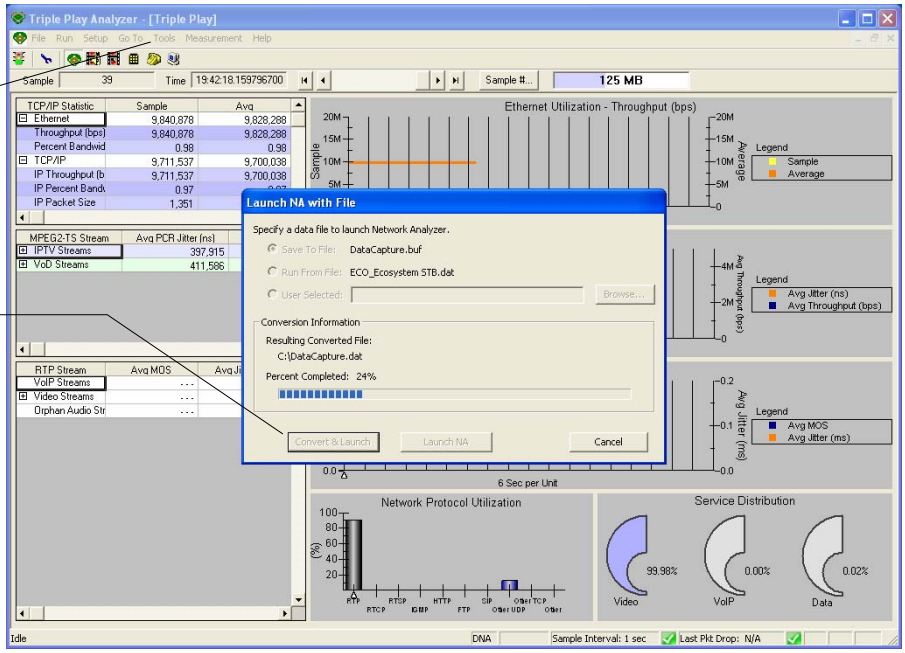

Both the video and audio PIDs in the transport stream are experiencing CC errors. To determine where the errors are occurring, it is necessary to view the decoded data in the Network Analyzer software, as described next.

## Convert the Data File

To analyze the CC errors in detail, convert the Triple Play Analyzer data file, C:\DataCapture.buf, as specified earlier when configuring the data source, and start the Network Analyzer software. Viewing the decoded data in post-process mode in the Network Analyzer software assists in finding the source of the problems.

Click Tools, and Convert File From .Buf to .Dat to convert the Triple Play Analyzer data file to a Network Analyzer data file.

Click the Convert & Launch button to generate an equivalent Network Analyzer data file and start the Network Analyzer software. The next step is to view the decoded data in the Network Analyzer software.




## Search the Network Analyzer Decodes for CC Errors

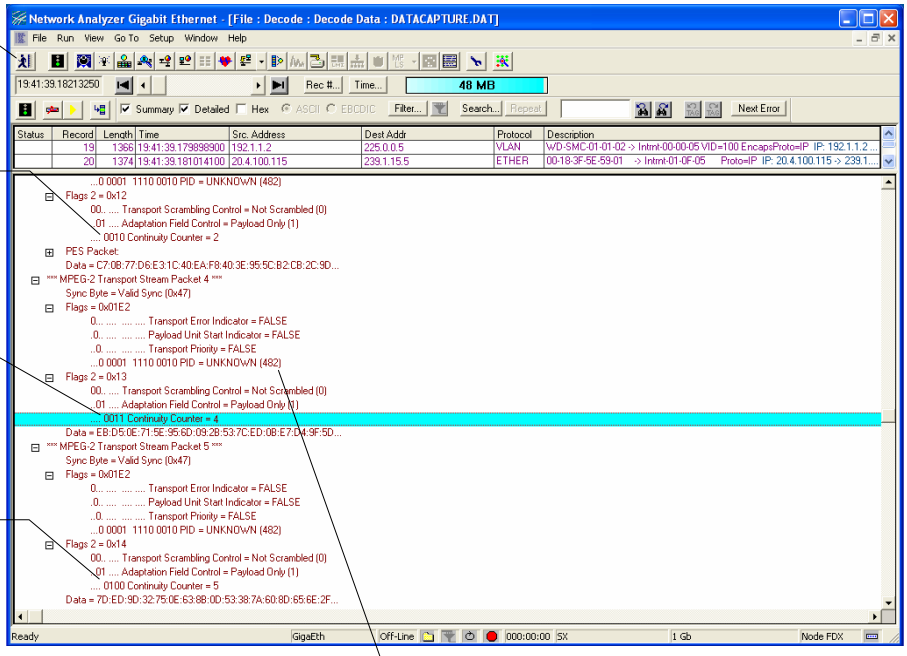
When the Network Analyzer software starts, the Decode view displays details for all frames captured by the Triple Play Analyzer, including errors in continuity counts. With its comprehensive suite of supported protocols, the Network Analyzer software easily decodes the data.

The Network Analyzer software starts and displays the decoded data captured over Ethernet.

Viewing the decoded data reveals the MPEG2-TS packets and their associated Continuity Counter values.

The following CC value is a non-incremental number, indicating that a CC error occurred in this packet.

The Continuity Counter resumed normal counts, and data capture continued.




CC errors are all occurring on the same PID.

### Interpreting the Results

Although the Content Provider is sending valid data, as is evidenced by the GOP pattern, the PCR jitter at the SHE encoder output is causing problems in the video and audio media as the streams are transported through the network. The PCR jitter forced some of the RTP packets out-of-sequence, which generated problems in routing the packets through the IP/MPLS transport network.

The 3-second delay factor in the Media Delivery Index revealed a delay in the transport stream, but, it may be negligible at the home network if the STB contains enough memory to buffer the delay. However, the loss rate component of the MDI measurement revealed loss of data in the video quality. The Video MOS Degradation measurement confirmed that the quality of the video had degraded to the point that it was no longer able to be rendered.

These problems are propagated to the end user at the home network by way of poor audio and video quality and slow channel zapping response times. Other devices at the home network experience these problems also, including delays in the audio and video media transport over IPTV to the end-user PCs, and noise and dropout in telephone line sessions.

Some of the problems found in this test scenario can occur at multiple points in the triple play network, such as at the output of each encoder, or each A Server, D Server, or VoD Server. By using the Agilent Triple Play Analyzer to test at multiple points in the triple play network, providers and network administrators can be sure to locate errors that occur in the major parts of the network – Super Head End (SHE), IP/MPLS Transport Network, Video Hub Office (VHO), and Home Network.

## Conclusion

Solving problems in a triple play network requires an understanding of the resulting measurement data. Having nominal measurement values defined before the problem occurs, and after the problem is fixed, can help ensure that the original quality is met.

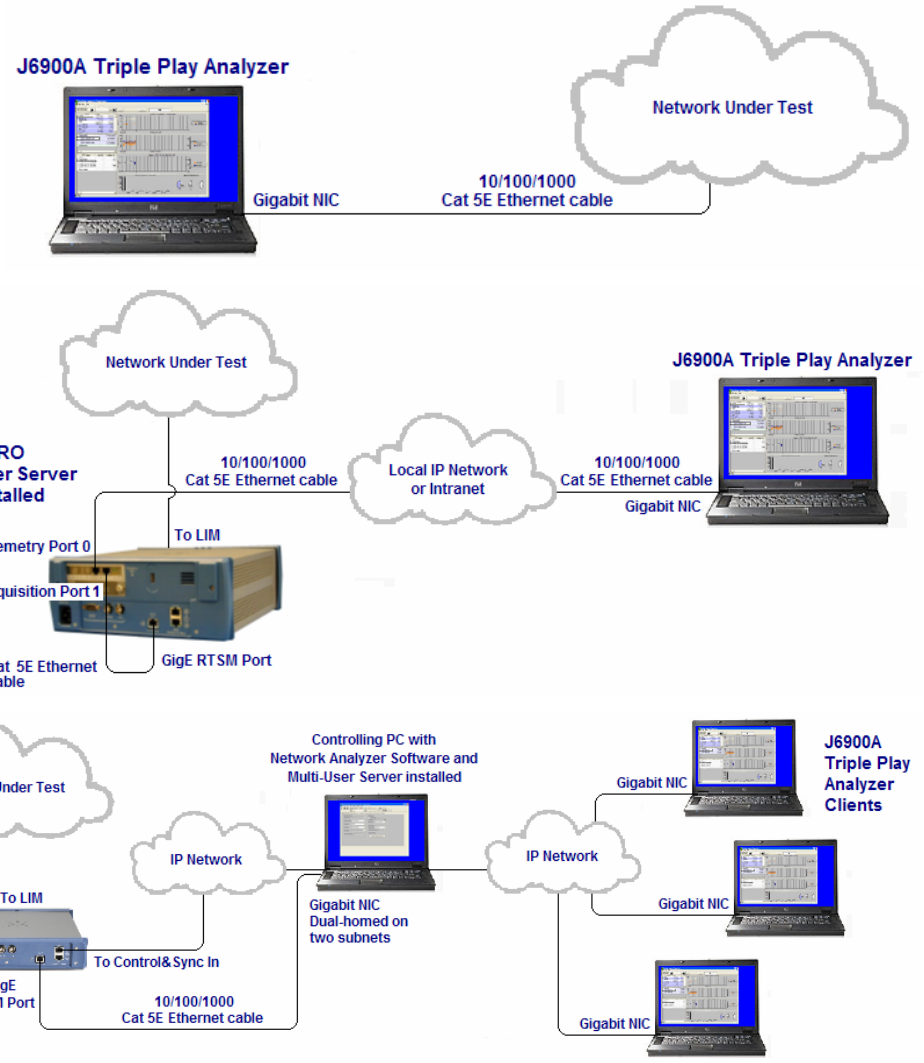
Analyzing the QoS and QoE of a triple play network requires investigating the media transport streams from the SHE, through the IP/MPLS network and the VHO, to the home network.

Errors can occur where least expected. And complications can arise in interpreting the variability of statistics in the end-to-end media transport, because the values can vary depending on where measurements are taken in the triple play network. To this end, service agreements between Content Providers and Service Providers must provide a means for interactive troubleshooting at each major point of the media transport through the triple play network.

To ensure high QoE for end users, complete triple play support for voice, video, and data is accomplished quickly with the Agilent Triple Play Analyzer, with support for measuring MPEG transport and ability, network transport issues, and loss pattern metrics, among many other statistics.

## Triple Play Analyzer Data Acquisition Use Models

The Agilent Triple Play Analyzer can be used with a PCI-E NIC to connect directly to the network under test. It can also be used with a J6801B DNA and the J6803A/B DNA PRO, both with RTSM capability. Several use models are shown here.




Request a technical document portfolio of the Agilent Triple Play Analyzer from your Agilent Representative today.

## Glossary of Terms

B-RAS – Broadband Remote Access Server

EAR – Ethernet Aggregate Router

DSLAM – Digital Subscriber Line Access Multiplexers

DVB – Digital Video Broadcasting

IGMP – Internet Group Management Protocol

IPTV – Internet Protocol Television

MDI – Media Delivery Index

MOS – Mean Opinion Score

MPEG – Motion Pictures Expert Group

OSI – Open Systems Interconnection

RTSP – Real Time Streaming Protocol

SIP – Session Initiation Protocol

RTP – Real Time Protocol

RTCP – Real Time Control Protocol

SHE – Super Head End

STB – Set-Top Box

VHO – Video Hub Office

VMOS – Video Mean Opinion Score

VoD – Video on Demand

VoIP – Voice over IP

## Related Literature

| | | |
|---|---|---|
| Agilent Triple Analyzer Software Technical Overview | Data Sheet | 5989-5783EN |
| Network Analysis and Troubleshooting Solutions Distributed Network Analyzer Platform | Data Sheet | 5989-5455EN |
| Network Analyzer | Data Sheet | 5988-4176EN |
| Network Analyzer | Technical Overview | 5988-4231EN |
| Distributed Network Analyzer | Brochure | 5989-3956EN |
| Protocol Communications | Poster | 5989-5245EN |
| IPTV Architecture – Network, Interfaces and Protocols | Poster | 5989-6897EN |

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