Agilent N2X

Testing IPTV Channel Zapping

Solution Note

IPTV channel zapping is a key element of the user’s QoE (Quality of Experience). Agilent N2X provides the most accurate and reliable channel zapping test solution that helps service providers and network equipment manufacturers evaluate if network equipment is ready to enable “Multiplay” services.
Introduction

Agilent N2X

Agilent N2X is the industry’s most comprehensive test solution for testing the development and deployment of network services for converging network infrastructures. Service providers, network equipment manufacturers (NEMs), and component manufacturers can verify service attributes of entire networks end-to-end, while also isolating problems down to individual networking devices and subsystems.

IPTV

Internet Protocol Television (IPTV) services, are being rolled out at an unprecedented rate as a key component of service providers’ “Multiplay” service offerings. These new services are expected to yield additional profits for Communication Service Providers (CSP) and allow increased competition in the television industry. The expectation of customers is high and the “quality of experience (QoE)” they receive from their IPTV service will be paramount.

“Multiplay” services, especially video services, are driving CSPs to upgrade to the next generation access network. Considering the huge investment and competition from Cable companies, CSPs cannot afford a service failure.

However, offering a competitive TV service over an IP network is challenging the infrastructure of CSPs network, especially access network. A standard IPTV channel using MPEG-2 encoding requires 3.5Mbps. If the service providers allow 2~3 channels per household and have other network services running on the same physical connection, the minimal requirement of access bandwidth will be at least 10Mbps or higher.

Before rolling out a new B-RAS (Broadband Remote Access Server), EAR (Ethernet Aggregation Router), or IP/Ethernet-based DSLAM (Digital Subscriber Line Access Multiplexer) in the access/edge network, thorough tests are required to make sure there is no barrier for achieving better QoE of IPTV service.
IPTV Channel Zapping

In addition to the bandwidth challenge, a key element of QoE for IPTV is the delay in changing channels - how long does it take to change from one channel to another? Does the customer get the right channel? If customers change channels in rapid succession, is the delay worse? What about if the network grows (more channels or more subscribers)? How are channel change times impacted by background unicast (VoIP or High-Speed Internet) traffic?

These are questions that service providers planning to offer IPTV services need to ask as they evaluate network equipment.

Changing IPTV channels will trigger a series of actions within network equipment. Zapping delay is generated by both the network and the Set-Top Box (STB). The N2X solution focuses on the measurement of network delay.

Multicast is one of the key technologies that enable the IPTV services. Each multicast group represents a TV channel. If there are thousands of users watching IPTV at the same time, it’s not necessary for the B-RAS and DSLAM to carry thousands of IPTV steams. The users watching a channel are included in a multicast group.

When they change to another channel, they just leave the group and join the new one. Technically, the network delay of channel zapping is mainly influenced by IGMP join/leave delay that can be regarded as control plane performance of IGMP.

Multicast protocols have been around for years but were rarely used in the traditional Internet infrastructure. Unpredictable multicast performance of network equipment becomes a serious barrier that slow down successful IPTV service delivery. Nowadays, some routers are still forwarding multicast packets by CPU other than hardware. Most ATM based DSLAMs cannot support multicast replication or lack of related multicast functions, such as IGMP snooping, IGMP proxy.

Even further, the IPTV services completely change the ratio of unicast traffic and multicast traffic in the networks. The video delivery network must handle multicast efficiently, both data and control plane.

To meet the QoE requirements of IPTV services, network equipment developers need to test their equipment to ensure the channel “zapping” delays are adequate to deliver the right service quality for service providers, and finally for end users.

Figure 1: Typical IPTV over DSL network Multicast model
Test Challenges of IPTV Channel Zapping

IGMP join and leave delay is the key focus of IPTV channel zapping measurement. But the ideal test solution for IPTV channel zapping is much more than a simple IGMP join/leave emulation. CSPs and NEMs have to solve a series of test challenges when they are trying to verify the QoE of channel zapping.

1. Accuracy and repeatability

A channel zapping action will involve several network elements, while acceptable QoE requires the delay through a single device should be no more than 100 msec. Accurate and repeatable measurement of every single device as well as the whole network will help the service provider isolate problems and avoid ‘finger-pointing’ issues among equipment vendors.

Accuracy and repeatability brings challenges to the testing equipment. Most network performance testers use a "hardware timestamp" in the data plane packets for latency measurement. But the control plane packets normally don’t carry a "hardware time stamp". Consequently, the timing of control plane packets has to be handled by the CPU of the tester rather than hardware. The accuracy of CPU based IGMP join/leave measurement is only in the range of 10s of ms. Considering the error overlapping of all the DUTs, obviously, the error is too big to have true evaluation of IPTV channel zapping time.

2. Realistic user environment emulation

In a realistic 'Multiplay' user environment, multiple network protocols like PPPoE and DHCP, as well as unicast and multicast user traffic are running simultaneously. Background protocol/traffic emulation will help create a realistic test environment for "channel zapping" measurements.

Service providers and content providers may use a range of encoding technologies, depending on the nature of the content (Standard Definition or High Definition), the bandwidth available in the network, and other factors. MPEG-2 (SD or HD), MPEG-4 AVC (H.264), and Microsoft Windows Media 9 are all commonly used. Thus, the test solution has to be capable of emulating a range of video traffic profiles.

To emulate the user behavior in a testing environment as close as reality, the test solution needs to support "multiple channels per household/subscriber" and all the users changing channels at a time" that always happens when TV commercials begin.

3. Scalability and reliability

The scale of the next generation access network is expanding rapidly. A DSLAM is physically accessing hundreds of subscribers. After being aggregated by the Ethernet or ATM switched network, a B-RAS has to consolidate the traffic of a dozen or more DSLAMs. To provide competitive IPTV content, service providers need to offer more than 100 channels for customers to choose. As a result, the IPTV channel zapping test bed has to emulate 1000s of subscribers and 100s of channels in a test scenario to be truly stressful and scalable.

Another scalability issue concerns hardware. The port count and port density in the access network is increasing rapidly nowadays. A fully loaded B-RAS will have dozens of hardware interfaces. As for the DSLAM or aggregation switch, the number of ports will be more than 100s. Accordingly, the test bed has to support equivalent port numbers and enable all the test capability in each interface.

Reliability of the test bed is a critical issue. "Long Duration service verification, 1000s of subscribers running both unicast and multicast traffic, subscribers' traffic and protocol flapping, multiple protocols running simultaneously, etc", all the test challenges build up a big challenge of reliability to the tester itself.
4. Full Coverage of related testing functionality

To fully test the performance and functionality of the SUTs for IPTV channel zapping, the test solution has to cover all the related protocols. IGMP snooping or proxy, which are used to optimize the multicast bandwidth in the network, has to be tested.

Hardware coverage is another important issue of the test solution. Fast Ethernet, Gigabit Ethernet and OC3c/12c ATM are the most widely used hardware interfaces in the access network. Some high-end B-RASs devices have also introduced 10 Gigabit interfaces. All hardware interfaces have to be tested.

Testing IPTV Channel Zapping using N2X

The N2X IPTV Channel Zapping solution offers service providers and equipment manufacturers a powerful application to accurately validate the channel zapping performance of broadband access equipment under real-world conditions. The full coverage of hardware interface and network protocols enables the most scalable and stressful test environment if channel zapping.

Moreover, the solution adopts an easy to user GUI and easy to understand result report. Test engineers will easily setup a complicate test scenario in a couple of minutes and get a well organized test report with diagram after the test finished.

Figure 2 shows a simplified network test scenario of IPTV channel zapping. Agilent N2X is emulating both the content provider and subscribers of IPTV service. The SUT(System Under Test) can be either a single network element such as B-RAS, IP DSLAM or a network system combined by B-RAS, DSLAM, Ethernet/ATM switches, etc.

Figure 2: IPTV Channel Zapping
Testing IPTV Channel Zapping

Features

Accurate hardware timestamping of both protocol emulation and traffic packets to 0.1 msec resolution

When performing any measurement, it is important to have both accuracy and repeatability, so you can be confident that your measurement truly reflects the performance of the DUT. Agilent N2X has unique hardware capabilities that allow the system to timestamp the protocol emulation (IGMP) packets and multicast traffic packets in real time and at high speed. Similarly, our state-of-the-art FPGA technologies allow us to perform highly accurate measurements in real-time, without relying on data capture and post-processing like other solutions on the market.

Measure channel zapping time on a per-subscriber or per-channel basis

It is important to measure the DUT’s contribution to the zap time for each subscriber and each channel, not just the aggregate performance of the device. N2X provides IGMP join, IGMP leave, and IGMP leave to join delay (channel zapping) measurements for each simulated subscriber (IGMP host) and for each channel (multicast group) and presents those results in tabular and graphical formats.

Scales to 100s of TV channels and 1000s of subscribers

To adequately characterize the channel zapping performance of your DUT, it is important to test under scaled conditions. Scaling the number of subscribers as well as the number of channels in the network are both critical factors. Service providers can then be confident that as more subscribers or channels are added to the network, channel zapping delays will not be adversely impacted.

Run IGMP, PPPoX, and DHCP sessions along with multicast & unicast traffic, all simultaneously on the same test port

Today’s converged networks are not used for a single service as in the past. The norm is becoming “Multiplay”, where IPTV, VoIP and High-speed Internet services are all offered on the same subscriber connection. For this reason, it is important to have background traffic in the test scenario to determine the impact of this traffic on the channel zapping performance of your DUT. N2X allows you to run background unicast traffic and other protocol emulations such as PPPoX and DHCP, to realistically determine the performance of your system with mixed services.

Channel "flapping" per subscriber

In a real-world network, each user will change channels with different patterns. It is important to be able to test according to different subscriber profiles and to test under different ‘stress’ conditions.

For example, what if a large number of subscribers all change to the same channel, such as at the beginning of a popular sports match? N2X allows you to configure channel ‘flapping’ profiles for all the subscribers in your test, and thus simulate many real world scenarios in your testing.
IGMPv2/v3 supported over Ethernet (with or without VLAN) and ATM (1483 Bridged/Routed, SNAP, VC-mux)

As access networks migrate from ATM to Ethernet, it is critical to be able to test your multicast network implementation using both technologies. The IPTV Channel Zapping software provides support subscribers on both ATM (OC-3c/12c) and Ethernet (10/100 and Gigabit) interfaces. VLANs can also be used to separate subscriber traffic on the Ethernet access interfaces. Multicast traffic can be sourced on any N2X interfaces, including Ethernet, POS and ATM, at rates up to 40Gb/s. Additionally, IGMP versions 2 and 3 are both supported.

IGMP Snooping and IGMP Proxy Reporting support

IGMP snooping or proxy reporting are used in today’s access network devices such as DSLAMs, OLTs, and EARs to optimize the multicast bandwidth used in the network. The N2X IPTV Channel Zapping solution can be used to test and characterized devices that implement either proxy or snooping functionality.

Well defined test cases cover the most popular test scenarios

The N2X IPTV channel zapping solution provides the most popular test cases that enable test engineers setup the tests quickly and get ready-to-go test results along with easy-to-read diagrams after the tests. The test cases include IGMP Join Delay, IGMP Leave Delay, Channel Zapping, Resilience to Peak Load, Sustained Performance, etc.

More Information

For further information about the N2X IPTV channel zapping solution and other test solutions on Multiplay testing, please visit: http://www.agilent.com/find/N2X or contact your Agilent Technologies representative.
Agilent N2X

Agilent’s N2X multi-service tester combines leading-edge services with carrier grade infrastructure testing and emulation. The N2X solution set allows network equipment manufacturers and service providers to more comprehensively test new services end-to-end, resulting in higher quality of service and lower network operating costs.

Warranty and Support

Hardware Warranty
All N2X hardware is warranted against defects in materials and workmanship for a period of 1 year from the date of shipment.

Software Warranty
All N2X software is warranted for a period of 90 days. The applications are warranted to execute and install properly from the media provided. This warranty only covers physical defects in the media, whereby the media is replaced at no charge during the warranty period.

Software Updates
With the purchase of any new system controller Agilent will provide 1 year of complimentary software updates. At the end of the first year you can enroll into the Software and Support Agreement (SSA) contract for continuing software product enhancements.

Support
Technical support is available throughout the support life of the product. Support is available to verify that the equipment works properly, to help with product operation, and to provide basic measurement assistance for the use of the specified capabilities, at no extra cost, upon request.

Ordering Information
To order and configure the test system consult your local Agilent field engineer.

www.agilent.com/find/n2x

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