# T-BERD®/MTS-4000 Class of Service (CoS) Test Suite

**By Dave Rerko**

The development of new Internet Protocol (IP)-packet based, so called Triple-Play, services (voice, video, data) delivered over the telco Access Network places new demands on network designs. Each of the services has their own specific quality of service (QoS) requirements, and all have varying bandwidth demands that are dynamic in nature, and, as a result, require prioritized treatment of the three services. In the access network, where bandwidth (BW) is often limited (digital subscriber loop [DSL] links, for example), BW allocation and control is critical. Furthermore, the mix of services supported must match the customer subscriptions and thus expectations: the number of high definition (HD) video streams, standard definition (SD) video streams, and voice calls supported simultaneously, and the amount of BW is provided for data service.

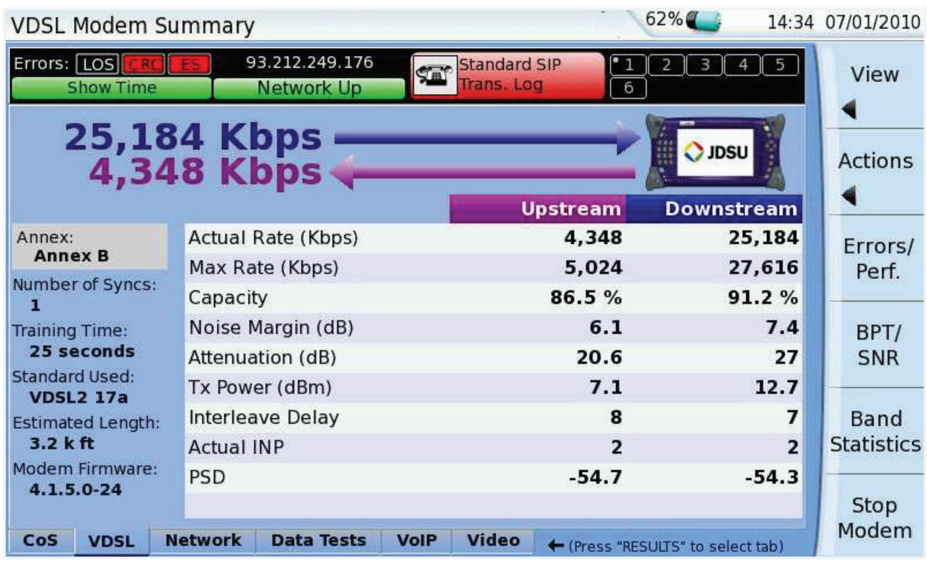
Many mechanisms exist for delivering the proper QoS for each service application. Several network design concepts are typically used to identify the data flows related to the three service types: and based on that, enable network equipment to treat the flows differently when resources become limited. Class of Service (CoS) refers to the treatment of different applications with associated requirements for how data flows are handled in the network. A CoS network design must include different strategies for dealing with congestion caused by peak BW demands, which can result in data loss and the need for error recovery. They include strategies such as:

- Resource and admission control (RAC)
- Virtual local area network (VLAN) application segregation
- Multiprotocol Label Switching (MPLS) guaranteed BW
- MPLS fast reroute
- Policing and marking on ingress routers
- Differentiated queuing and dropping on core links
- Shaping (or policing, based on line speeds and hardware deployed in the network) and differentiated queuing on egress links

Regardless of the approach a given network may utilize, validation of CoS performance remains critical, especially in the access network where BW is often limited. The interaction between competing application BW demands may affect the individual QoSs. Testing individual applications in a sterile environment will not reveal problems that manifest in the presence of mixed application traffic flows, thus requiring a robust CoS Test Suite to analyze these interactions.

## A Real-World Example

The true test of a network and how the CoS mechanisms are working is realized when sequencing multiple application online and then gaining an understanding of the interaction between the different services. In the example below, the maximum DSL BW is 25 Mbps based on the Actual Rate sync of the VDSL2 modem.



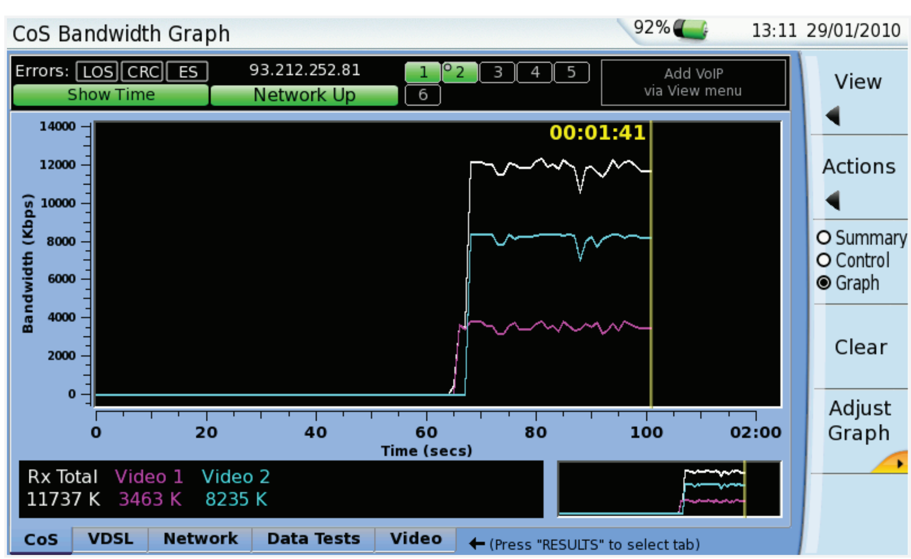

Therefore, considering the various encapsulations, the actual useable BW for different services is about 4 percent less, in this case 24 Mbps.

As depicted below, the Data stream (red) is sequenced online first and then shows the BW varying during a window size negotiation before peaking at about 12.25 Mbps. Video stream 1 (Purple) is a Standard Definition (SD) video stream with a variable bit rate averaging about 3.75 Mbps. Shortly thereafter adding a third stream (light blue) to the mix. This is a High Definition (HD) video stream with a variable bit rate and an average BW of about 8.75 Mbps. At this point, the total average BW is about 24 Mbps (8.75+12.25+3.75), essentially allocating all of the available BW in this particular example.

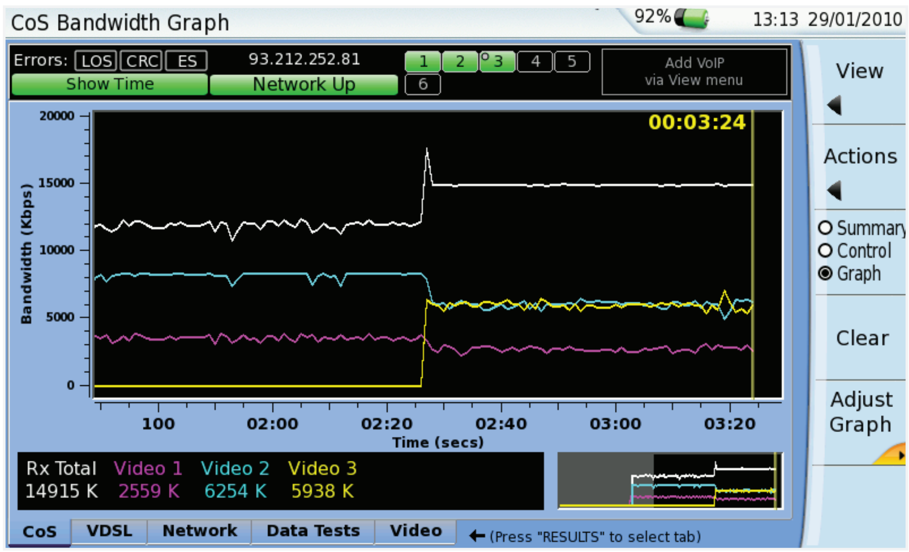
When sequencing a fourth stream online, as shown in the example below, an HD stream (yellow) should be running at 8.75 Mbps, instead the total BW demand exceeds the 24 Mbps maximum. In reaction to the BW demand, the network compensates by simply modifying the BW for all streams so that the total BW demand is 24 Mbps. As a result, it destroys the QoS for the video services. Massive packet loss occurs on all three video streams and the quality of the video and audio becomes unacceptable to the user. This is an example of a network where the Admission Control and CoS mechanisms are not working or have not been implemented properly.


Using this example, a typical test approach that addresses each application individually would result in a total BW demand of about 21 Mbps for the video application, (all three video streams: 8.75 + 3.75 + 8.75 = 21.25 Mbps) under the 24 Mbps maximum. There would have been no packet loss, leading one to believe the system was operating correctly. However, with no data application active, the impact of a real-world mixed application environment would remain untested and the data service impact would remain unseen, resulting in customer trouble calls upon establishing the mixed traffic.

In another example shown in the graph below, video service is capped at 15 Mbps leaving BW for voice and data services. The first screen shows two active video streams: Video 1 SD stream with a BW of 3.463 M and Video 2 HD stream with a BW of 8.235 M for a total of 11.737 M as shown by the white line graph.



The graph that follows clearly shows the effects of adding a third video HD stream, exceeding the 15 M limit. The network responds by reducing the BW for the two HD streams from about 8 M each to 6.254 M and 5.938 M, respectively, resulting in massive packet loss. The Total line graph shows the newly combined total BW at 15 M. Adding a data flow to this particular test would reveal that the data application would not impact the video flows, because data service BW is reserved separately from the video service in this network example.




In these cases, it is difficult to identify the root cause or perform timely trouble resolution, without the ability to test the interaction of video, voice, and data services together. The individual application tests cannot duplicate the failure or clearly show the interaction between streams. With the many different CoS configurations deployed in today's IPTV networks, use of this CoS test concept is important for proper, new service installation testing. Validating that the CoS setup is working correctly is critical. It is also a valuable tool for use in trouble resolution testing.

## Summary

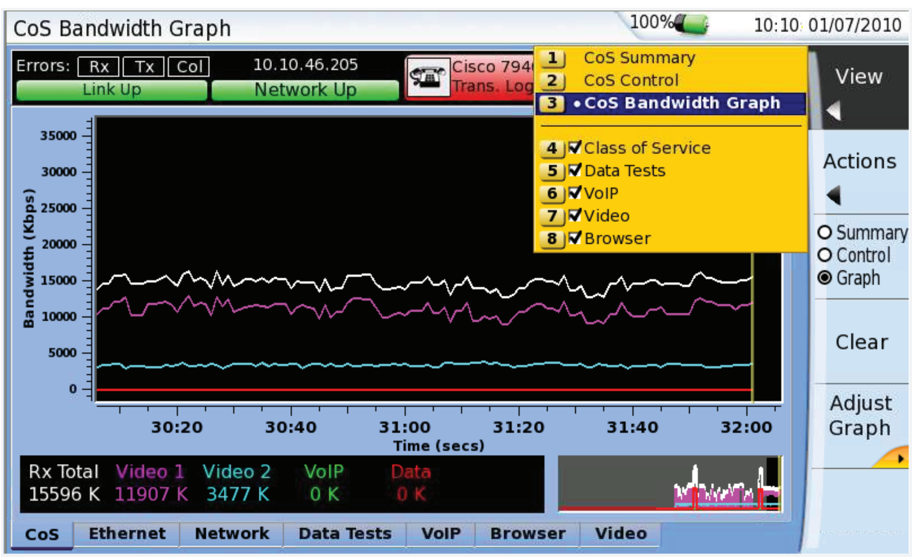
The CoS Test Suite enables the field technicians/engineers to validate that CoS mechanisms are performing correctly in a real-world mix of applications. In the Access network, where BW is often limited, CoS analysis may reveal interaction problems or BW-limitation problems that would otherwise remain unidentified. A CoS test should be standard in a new service installation test process. A CoS Test Suite also serves as an important tool for dealing with some trouble-resolution cases.

## CoS Operation Detail

### The CoS Test Suite

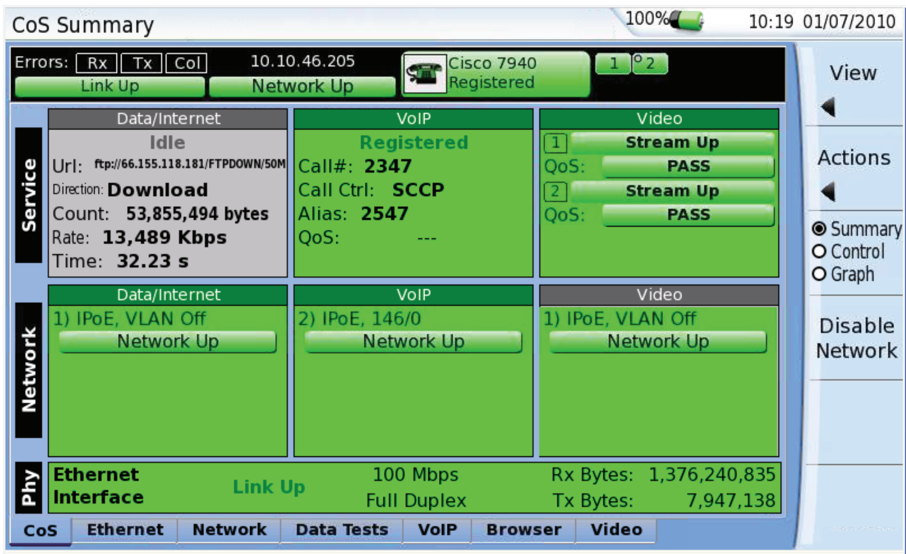
- Enables testing of all three applications simultaneously and allows analysis to reveal their interaction emulating the real-world mixed traffic environment
- Applications are those supported on the instrument, and the CoS does not limit or change them.
- Operates only in the Terminate mode
- Operates over DSL or Ethernet test access points
- Patent application based on the ability to bring up all three applications simultaneously for the purpose of showing their interaction
- First of its kind in the industry

As the screen below shows, users can select the CoS from the view-level graphical user interface (GUI). When selected, a new tab and GUI appear, as shown below.

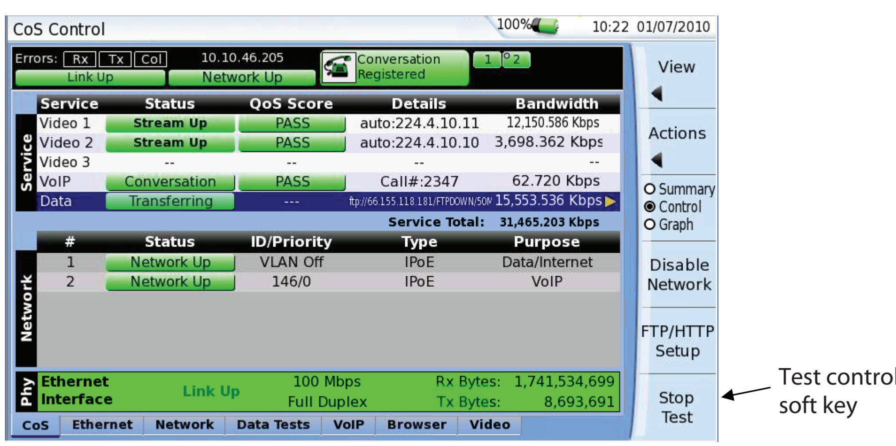


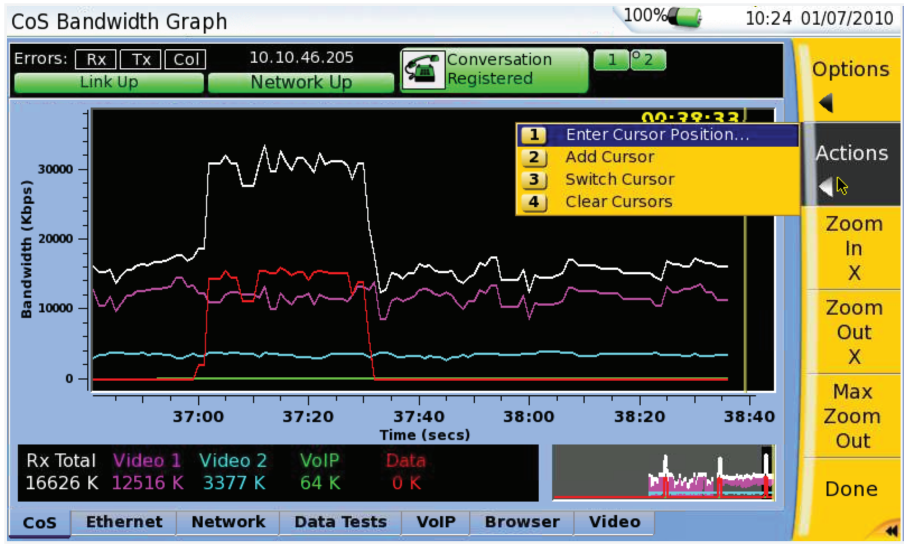

The CoS Summary screen shows the QoS status for each of the three applications: Data first, VoIP second, and Video third (also shown below). Green indicates passing QoS for VoIP and Video, yellow indicates marginal results, and red indicates a failure. The QoS are field-settable based on a providers' methods and procedures. It displays the Network status as well as the Physical interface. Errors on these also cause similar color changes from green to yellow to red.

In the CoS Test Suite, all three applications can run simultaneously to validate whether multiple streams can run at once and to ensure that the network CoS mechanisms are working correctly. Adding new steams lets users see if a negative impact occurs on the existing streams. For example, users can determine whether adding a third video stream which exceeds the total BW available, degrades the existing streams, or causes it to fail to come up at all. In the example screen below all three applications are running with two video streams, one VoIP call, and ftp data idle in the background; but what if you wanted to start the FTP test?



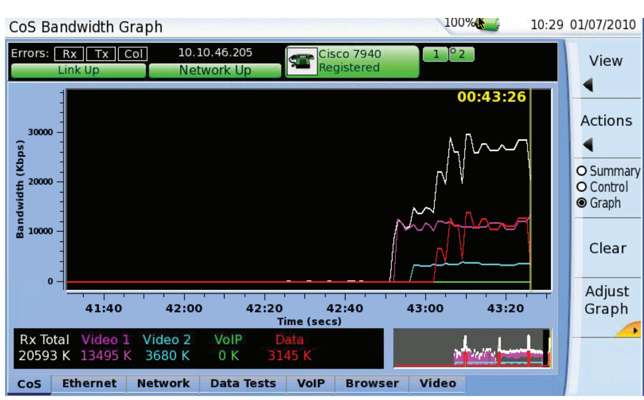

The Control Screen allows users to access the stream and turn the service on or off. With a stream highlighted, press the bottom right-hand soft key to control the start and stop actions for the stream. For video, it is Start Stream; for VoIP, it is Place Call; for Data, it is Start Test. Details provide the stream address, the number called, and the FTP site. It also displays the actual bandwidth along with the total services BW. For reference, this screen also shows the physical layer BW possible for the test access point. On a DSL interface, this is the maximum BW available. For the maximum possible application BW on a DSL link, reduce the DSL (physical layer BW) maximum by 4 percent to consider the encapsulation of the packetized data.






Selecting graphs moves users to the Bandwidth screen, where:

- Labels at the bottom coordinate with the stream colors
- The Adjust Graph button provides access to zoom control and a second cursor
- Zoom in and zoom out and works similar to other graphical displays on the T-BERD/MTS-4000
- Use the second cursor to determine time intervals with the delta symbol
- Labels at the bottom show elapsed time in seconds from the start of a stream. The graph can show about 120 seconds of data.
- Access a world view of the graph using the touchscreen
- The graph shows all active streams along with the total. The example below shows three streams operating.




Graph colors match BW metrics

Viavi Solutions™ offers the industry's most comprehensive CoS Test Suite via a patented software option available for the HST-3000 Handheld Services Tester and T-BERD®/MTS-4000 Multiple Services Test Platform.

Contact Us **+1 844 GO VIAVI**
(+1 844 468 4284)

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visit viavisolutions.com/contacts.


t-berd4000cos-an-fop-tm-ae
30162980 900 0210