# Implementing Traffic Engineering over Global SDX Testbed

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## Introduction

In order to meet the needs of inter-domain transmissions for data intensive sciences and applications, we have setup an adaptive SDX network testbed based on SDN-IP technology with efficiency, elasticity, security, and convenience. Several institutions and research organizations from Asia countries and US joined this testbed and experiments and demonstrations are made during past few years. In this demonstration, we would like to explore traffic engineering mechanism over global SDX testbed. A multi-stream video is transmitting over the backbone and the SDX software will route the streams over different paths according to current network status to ensure the video quality at the receiving viewer.

For the demonstration, we modify a open-source video software to support multi-stream transmission. SDX software is also developed to perform the traffic engineering on the streams of the transmitting video. Based on our previous works, the global topology of the testbed can be auto-detected for our SDX software to discover all possible paths between video server and client for routing decision. Finally, the paths of these streams are depicted on a graphical UI to present the results of the traffic engineering mechanism.

## Traffic Engineering with Multiple Video Streams

For data transmission across several SDN-IP sites, there is only one single route between two Autonomous Systems according to BGP routing protocol. As shown in Figure 1, there is a video client located in ASN 65003 is requesting streaming from server in ASN 65001. The video will traverse the shortest path ASN 65001 - 65004 - 65006 - 65003. The server could send the video into multiple streams in order to increase transmission rate. Nevertheless, since these steams follow the same path, we may encounter bottleneck on backbone link between ASN 65004 and 65006.

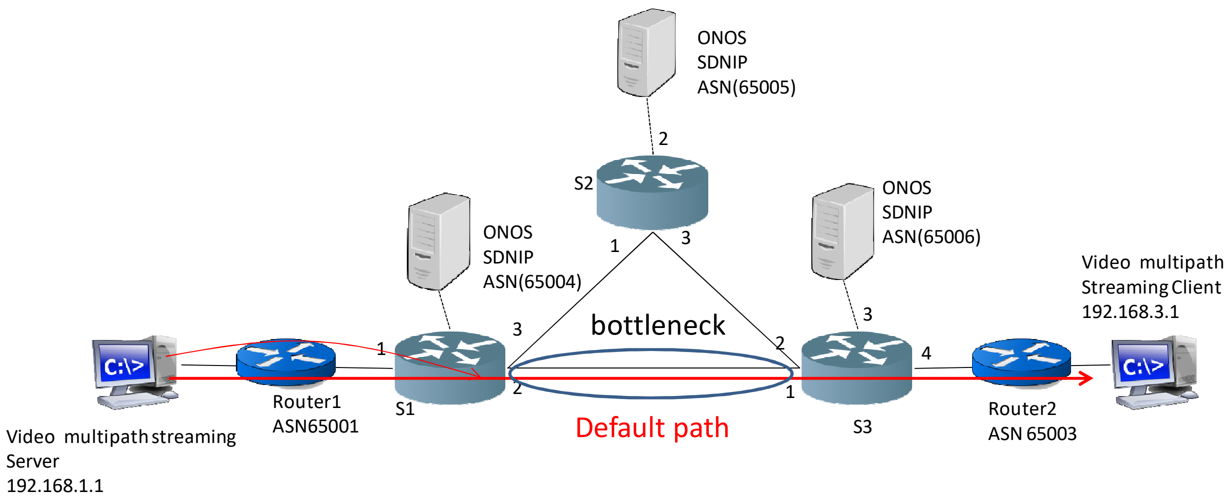



**Figure 1** Video Transmission without Traffic Engineering

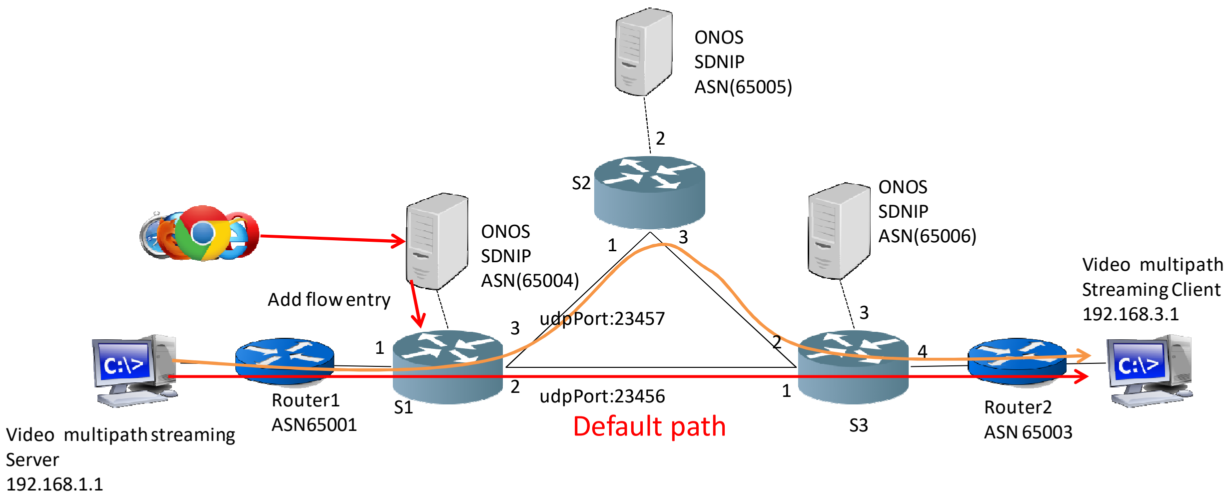
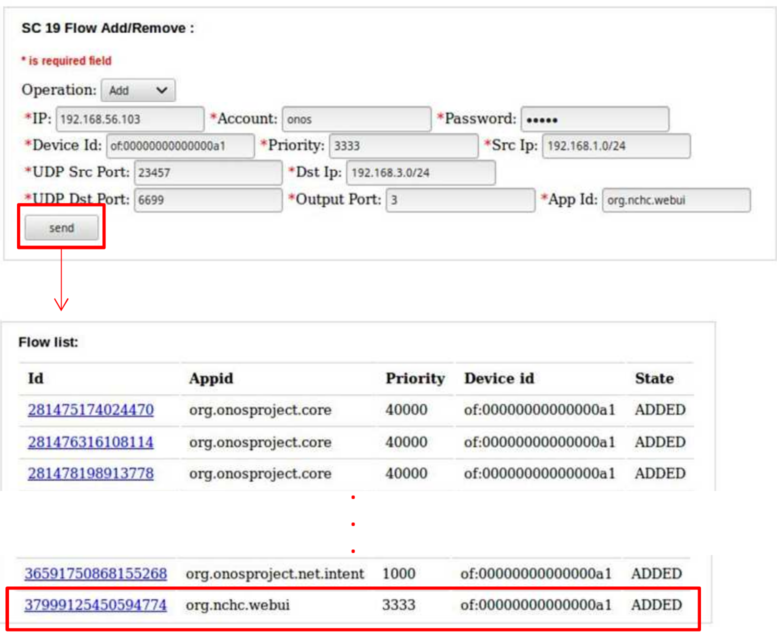



**Figure 2** Traffic Engineering for Multi-stream Video Transmission

To resolve such issue, we utilize the topology discovery function over SDN-IP so that several backup paths could be calculated. A user interface is developed for admin or user to decide whether their traffic should be transmitted through these backup routes. As illustrated in Figure 2, the server sends the video into two streams with UDP ports 23456 and 23457. We can configure that the path for video stream with UDP port 23457 traverse the backup route ASN 65001 - 65004 - 65005 - 65006 - 65003.



SC 19 Flow Add/Remove :

* is required field

Operation: Add

*IP: 192.168.56.103 *Account: onos *Password: •••••

*Device Id: of:00000000000000a1 *Priority: 3333 *Src Ip: 192.168.1.0/24

*UDP Src Port: 23457 *Dst Ip: 192.168.3.0/24

*UDP Dst Port: 6699 *Output Port: 3 *App Id: org.nchc.webui

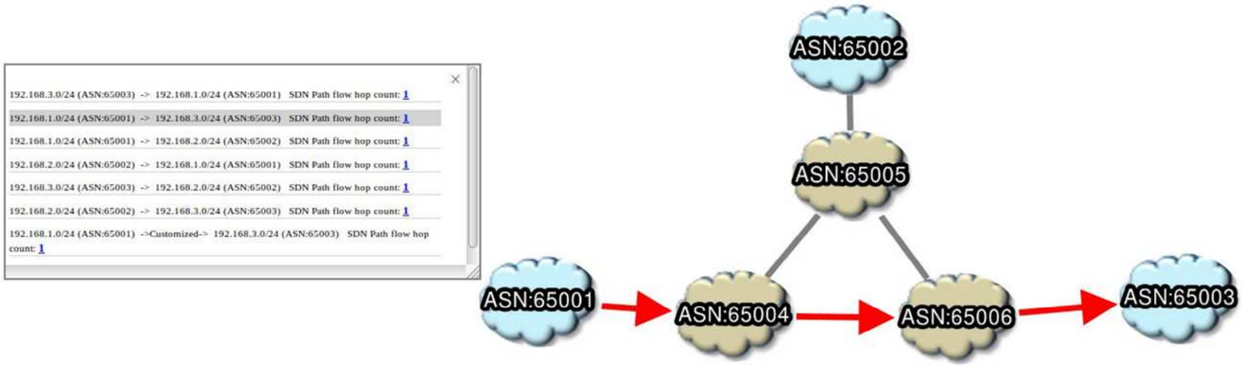
send

Flow list:

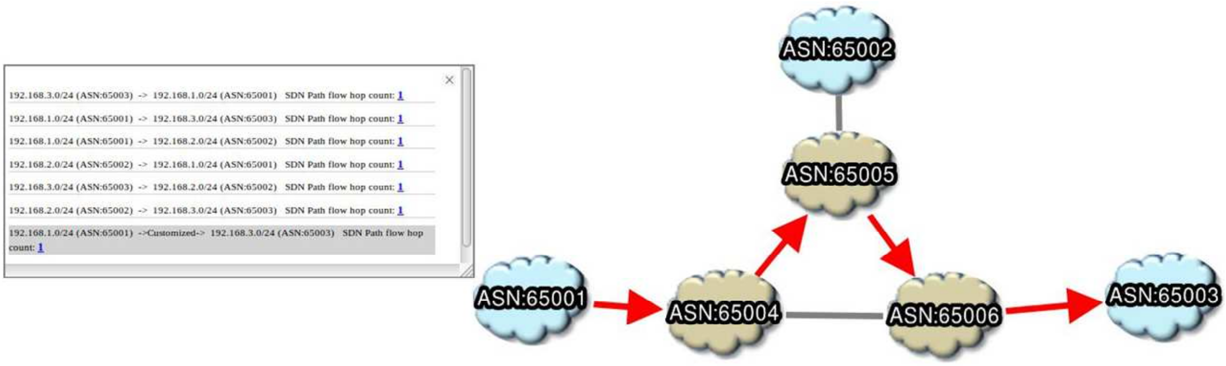
| Id | Appid | Priority | Device id | State |
|---|---|---|---|---|
| 281475174024470 | org.onosproject.core | 40000 | of:00000000000000a1 | ADDED |
| 281476316108114 | org.onosproject.core | 40000 | of:00000000000000a1 | ADDED |
| 281478198913778 | org.onosproject.core | 40000 | of:00000000000000a1 | ADDED |
| . | | | | |
| 36591750868155268 | org.onosproject.net.intent | 1000 | of:00000000000000a1 | ADDED |
| 37999125450594774 | org.nchc.webui | 3333 | of:00000000000000a1 | ADDED |

**Figure 3** UI for Configuring Traffic Flows

Figure 3 depicts our developed UI, admin or user could edit flow rules to control the traffic path. We configure a new flow in controller at ASN 65004 that forward video stream with UDP port 23457 to ASN 65005 (port 3). We can then view the end-to-end flow paths in Web UI. The video stream with UDP port 23456 follows the default path as shown in Figure 4(a); while the stream with UDP port 23457 is re-routed on the backup path in Figure 4(b).




(a) UDP port 23456




(a) UDP port 23457

**Figure 4** End-to-End Flow Path Viewer

## Conclusion

By incorporating the BGP into the SDN network, SDN-IP combines the strength of both legacy L3 and SDN worlds, enabling the coexistence and intercommunication of SDN network and traditional Internet. However, there is only one route between two Autonomous Systems decided by BGP protocol. With SDN, we could easily enable traffic engineering by configuring the flows at controller. In the demonstration, we show our developed UI to operate traffic engineering for multi-stream video transmission. By traversing different route over SDN-IP backbone, we could balance the traffic load and avoid congestion bottleneck.

## Involved Parties

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- Jen-Wei Hu, NCHC
- Li-Chi Ku, NCHC
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- Te-Lung Liu. NCHC
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- Naomi Terada, NICT
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- Tzu-Ying Fang, NCKU
- Chu-Sing Yang, NCKU
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- Jim Chen, iCAIR
- Fei Yeh, iCAIR
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- Linh Truong Dieu, HUST
- Phạm Dinh Lam, VNU
- Chalermpol Charnsripinyo, NECTEC
- Luke Jing Yuan,MIMOS

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