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# 1 Optimizing uplink channel

How the VAS Experts DPI can help you to reduce uplink costs by 25% while increasing QoE?

## Entry conditions:

If you look at a weekly channel usage graph of a typical home telecommunication operator, you can see that the peek value usually is reached on the most busy hours (MBH), when everyone is resting after working hours and spend their leisure time on the Internet: download and watch movies, listen to music, visit entertainment portals, etc.

> ⚠️ The peak of the channel usage occurs about 23 hours and usually lasts less than an hour, exceeding normal rates by 30%. And meanwhile, the torrent traffic at this time can occupy up to 30% of the channel capacity, about 50% accounts for viewing online video, everything else accounts for only 20%.

## What we want to get:

> ⚠️ To suspend the increasing of channel bandwidth by optimizing usage of available bandwidth by different types of traffic.

There is a strong temptation to avoid paying for the "extra" bandwidth, which is needed only for an hour and the rest of the time is merely not used. But if you just don't pay, then your users will notice problems at a rush hour such as: glitches may occur when watching videos, websites may become unavailable, online games may become running slow and IP calls can not be held. The operator will never accept this strategy because, it is essentially prime time and users need high-quality Internet at exactly this time. How about this situation here? Operator wants to save money, and at the same time it is required to deliver high-quality Internet to the end user, and to make him pleased with services provided.

## Tools:

The VAS Experts DPI options to use:

- Gathering and analysis of statistics on protocols and directions
- Optimizing the use of external access channels

Additional Modules:

- For receiving, processing and storing NetFlow - QoE Store statistics software.
- For visualization and generating reports - DPIUI2 graphical interface.

## Configuration:

Let's divide the traffic into classes depending on the protocol used. There are can be assigned in total up to 8 classes, which the VAS Experts DPI can use to label the packets both in the DSCP/TOS field of IP headers and the VLAN/MPLS priority field, and then the external platform can control QOS. But we will consider the case when the VAS Experts DPI does it on its own. We place in the lowest priority class all the services that we can afford to be limited during peak hours. Usually these are services having the speed depending on external factors, it's the case when the user doesn't use the service in interactive mode but instead in the background one. The examples of such a services are: downloading files via torrent trackers, software update services and maybe something else specific to your case. Online broadcasting services being able to adapt to the available bandwidth and select the quality needed should be placed in a class with a higher priority, and, finally, in the highest priority class we should place interactive services, which operation is controlled by the user in online mode, so when the problems occur, they will become immediately perceptible; these are web browsing, online games, IP-telephony (SIP, Skype). And to put it simple, we will place everything else in this class. There are exist two approaches for limiting traffic for each class: to limit the maximum bandwidth that the traffic of corresponding class can occupy, or rely upon the mechanism originally provided by the VAS Experts DPI allowing to borrow bandwidth automatically. In the latter case, the VAS Experts DPI will begin to limit traffic based on classes only when the usage of the incoming traffic bandwidth approaches its threshold value. And furthermore, the bandwidth should be bounded from the bottom side in order to get a certain traffic class be affected by latencies only within the controlled limits during peak loads.

If the upper bandwidth limit for a given class is exceeded, the outgoing traffic of this class is limited by the VAS Experts DPI, in this case the bandwidth is decreased evenly for all the subscribers. Due to the "two-way" nature of the most protocols (request-response and subsequent transmission-acknowledgement are used), the restriction of outgoing traffic leads to the restriction of incoming one. When the VAS Experts DPI automatic control mode is used, the degree of this influence is determined using the feedback mechanism, i.e. at first the traffic of the minimum priority will be affected to restriction until the minimum threshold is reached. If this restriction is not enough, then the restriction will be applied to the next priority traffic, and so on and so forth. Both modes allow you to use the mechanism of borrowing bandwidth when unused bandwidth is allocated between classes according to current needs and is reallocated when needed.

## Configuration example for the description given above

Create protocols.txt file:

```
default cs0
mpeg     cs1
bittorrent cs7
```

Convert protocols.txt to protocols.dscp

```
cat protocols.txt|lst2dscp /etc/dpi/protocols.dscp
```

Put hard class-based restrictions to the /etc/dpi/fastdpi.conf configuration file, according to the statistics graph (simple solution, but far from being perfect)

```
#Limit outbound torrent
tbf_class7=rate 50mbit
#Limit inbound torrent
tbf_inbound_class7=rate 50mbit
```

Another way is to let the DPI to prioritize protocols in a class hierarchy independently within the entire available bandwidth (it requires upper bounds parameters to be selected to account for steep traffic increases, to ensure the restriction occurs based on dpi priorities, rather than because of the physical channel exhaustion, here, for the starting point the channel width minus 10% can be taken, in case of torrents, 50% should be subtracted)

```
htb_inbound_root=rate 180mbit
htb_inbound_class0=rate 100mbit ceil 180mbit
htb_inbound_class1=rate 50mbit ceil 180mbit
htb_inbound_class2=rate 8bit ceil 180mbit
htb_inbound_class3=rate 8bit ceil 180mbit
htb_inbound_class4=rate 8bit ceil 180mbit
htb_inbound_class5=rate 8bit ceil 180mbit
htb_inbound_class6=rate 8bit ceil 180mbit
htb_inbound_class7=rate 10mbit ceil 100mbit
htb_root=rate 180mbit
htb_class0=rate 100mbit ceil 180mbit
htb_class1=rate 50mbit ceil 180mbit
htb_class2=rate 8bit ceil 180mbit
htb_class3=rate 8bit ceil 180mbit
htb_class4=rate 8bit ceil 180mbit
htb_class5=rate 8bit ceil 180mbit
htb_class6=rate 8bit ceil 180mbit
htb_class7=rate 10mbit ceil 100mbit
```

Restart the DPI

```
service fastdpi restart
```

## Result:

Only traffic that is less critical to the end users will be affected by latencies, and the time-sensible online services that are important for the user, will be delivered faster and with minimal delays as a result of prioritization. We managed to reduce the requirements for channel width, and, from the user the point of view, the Internet acces has become faster.
Bonus: Во время пиков трафика большая нагрузка ложится и на другое используемое оператором оборудование и оно может начать под нагрузкой вносить свои дополнительные проблемы – терять пакеты, увеличивать время отклика и т.п. Внедрение шейпинга СКАТ позволит предотвратить превышение критической нагрузки для оборудования, после которой возникают проблемы, и отложить необходимость его апгрейда на более поздний срок.

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