Dynamic Traffic Management (DTM) for minimization of inter-domain traffic cost

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Socially-aware Management of New Overlay Application Traffic with Energy Efficiency in the Internet
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Background

- The content is not available locally
  - The download will generate inevitable inter-domain traffic
- The cost of the downstream traffic depend on the tariff on inter-domain link used
- Optimize total cost of inter-domain traffic
- Manage the traffic:
  - Selection of content source (multiple resources available, communicate with overlay application, e.g. by using ALTO)
  - Select the path, e.g. by using tunnels (might be transparent to or cooperate with overlay)
Traffic management

Total amount of traffic in each period $n$ remains the same, but the traffic is differently distributed among two links.

TARGET traffic (cost) to be achieved in the current period

manageable traffic

non-manageable traffic

5 min samples

Link 1

$\begin{array}{c}
n-1 \\
n \\
n+1 \\
n+2 \\
n+3 \\
n+4 \\
\end{array}$

TARGET traffic (cost) to be achieved in the current period

5 min samples

Link 2

$\begin{array}{c}
n-1 \\
n \\
n+1 \\
n+2 \\
n+3 \\
n+4 \\
\end{array}$
Basic assumptions

- Tariffs based on total traffic volume or 95\textsuperscript{th} percentile
- Upstream and downstream traffic management

- Find cost-optimal traffic distribution on inter-domain links

- Goal – minimize cost by the end of accounting period – long time scale
- Influence traffic distribution dynamically on short time scale
- Observe traffic on links
- Periodic measurements and estimation of final cost
- Influence the manageable traffic by selecting path for flows
Sample use-case

- Cloud agnostic
- Tunnels (GRE or MPLS) between DAs (Data Center Access router) located in different ISP domains
- Simple management in DAs
  - Recognize flows
  - Choose appropriate interface (tunnel) for the flow
  - SDN controller
- Agreements between ISPs may be needed
DTM – traffic management concept

[Diagram showing traffic management concept with labels for Optimization algorithm, Compensation algorithm, and Metering component.]

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DTM – traffic management concept

Finds optimal goal vector $D_t$

Calculates compensation vector $U_t$, e.g., every 5 min and influences path selection

Monitors current traffic on inter-domain links and calculated measured vector $X_t$
  e.g., every 30s
  e.g., (modified) NetFlow

Optimization algorithm

Compensation algorithm

Metering component
Example more detailed example

- Frequent traffic measurements (per epoch)
  - 5-min slot divided into a number of epochs
- Per epoch reaction: compensation vector is recalculated after each epoch
- The compensation vector says how much traffic should be shifted from one link to the other to keep the sample small enough and achieve target cost (in terms of 95\textsuperscript{th} percentile)
Simulation results – 95th percentile tariff

Link 1: Sorted 5 min samples of traffic

Cumulated traffic volume on links
- Without compensation
- With compensation
- Goal vector of traffic

Link 2: Sorted 5 min samples of traffic

Sample size [GB]
- 95th percentile thresholds
- w/o compensation
- with compensation

Traffic on link 2
- 1000
- 800
- 600
- 400
- 200
- 0

Traffic on link 1
- 1400
- 1200
- 1000
- 800
- 600
- 400
- 200
- 0
Questions?