1 Modeling of the P2P service migration problem

Notation definition:

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C_s: storage capacity of the on-premise server
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 C_u : upload bandwidth capacity of the on-premise server

h: charging rate for storage on the cloud

k: charging rate for upload bandwidth on the cloud

N video:
$$V_i, i = 1, ..., N$$

$$s_i$$
: storage of $i - th$ video

 $x_i^c=\{0,1\}, i=1,...,N$: $x_i^c=1$ if the placement of the i-th video is on the cloud; $x_i^c=0$ otherwise;

 $x_i^s = \{0,1\}, i=1,...,N$: $x_i^s = 1$ if the placement of the i-th video is on the on-premise server; $x_i^s = 0$ otherwise;

W: current total upload bandwidth demand of all videos.

 p_i : popularity of the i-th video, i.e., the upload bandwidth is Wp_i .

1.1 Optimization of the problem

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\begin{aligned} & \min \sum_{i=1}^{N} (Wp_ik + s_ih) x_c^i \text{ (minimizing the spending cost)} \\ & \text{subject to:} \\ & x_i^s + x_i^c = 1, i = 1, ..., N \text{ (assume that each video has one copy)} \\ & x_i^c = \{0,1\}, i = 1, ..., N \\ & x_i^s = \{0,1\}, i = 1, ..., N \\ & \sum_{i=1}^{N} s_i x_i^s <= C_s \text{ (on-premise server's storage constraint)} \\ & \sum_{i=1}^{N} Wp_i x_i^s <= C_u \text{ (on-premise server's upload bandwidth constraint)} \end{aligned}
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1.2 Second definition of the problem

In Sec. 1.1, we assume C_s and C_u are given and the cost of on-premise server is fixed. If these are not given and fixed, the optimization of the problem becomes:

Introducing more notations:

u: charging rate for storage on the on-premise server

v: charging rate for upload bandwidth on the on-premise server

The optimization problem is:

$$\min \sum_{i=1}^{N} (Wp_i k + s_i h) x_c^i + uC_s + vC_u$$
 subject to:

 $x_i^s + x_i^c = 1, i = 1, ..., N$ (assume that each video has one copy)

$$\begin{array}{l} x_i^c = \{0,1\}, i=1,...,N \\ x_i^s = \{0,1\}, i=1,...,N \\ \sum_{i=1}^N s_i x_i^s <= C_s \text{ (on-premise server's storage constraint)} \\ \sum_{i=1}^N W p_i x_s^i <= C_u \text{ (on-premise server's upload bandwidth constraint)} \end{array}$$