

## 0.1 Main algorithm

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**Algorithm 1:** main algorithm

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**Input:** Demand matrix DM

**Output:** Routing  $\phi_{best}$  (Fraction of demand)

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1 Initialization :  $D = \{\text{DM}\}$ ,  $\text{DM}_{worst} = 0$ ;
  //  $D$  is the set of demand matrix
2 while not meet the cutoff condition do
3    $D = D \cup \text{DM}_{worst}$ ;
4   Find the best routing  $\phi$  of  $D$ ; // The First model
5    $\phi_{best} = \phi$ ;
6   Find the worst demand matrix  $\text{DM}_{worst}$  of  $\phi_{best}$  // The
      second model
7 end
8 return  $\phi_{best}$ 

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## 0.2 Original model in the paper

$$\begin{aligned}
 & \min \alpha \\
 & \phi \text{ is a PD routing} \\
 & \forall \text{ edges } e = (u, v) \\
 & \forall \text{ DMs } D \in D \text{ with } OPTU(D) = r : \\
 & \sum_{(s,t)} \frac{d_{st} f_{st}(u) \phi_t(e)}{c(e)} \leq \alpha r
 \end{aligned} \tag{1}$$

$$OPTU(D) = \min_{\phi | \phi \text{ is a PD routing}} MxLU(\phi, D) \tag{2}$$

### 0.3 Model 1 : The first model

Find the best routing  $\phi$  of the given set of demand matrix to minimize maximum link utilization

$\min \alpha$  (Minimize maximum link utilization)

$$\sum_{e=(v,u) \in E} \phi_{st}(e) - f_{st}^i(u) = \begin{cases} 1 & \text{if } u = s \\ -1 & \text{if } u = t \\ 0 & \text{others} \end{cases}$$

$$, \forall (s, t) \in V \times V, 1 \leq i \leq |D|, \forall u \in V \quad (\text{Flow conservation})$$

$$\sum_{(s,t)} \frac{d_{st}^i f_{st}^i(u) \phi_{st}(e)}{c(e)} \leq \alpha, \forall e \in E, 1 \leq i \leq |D| \quad (\text{Link capacity constraint})$$

$$0 \leq \phi_{st}(e) \leq 1, \forall e \in E \quad (\text{Decision variable constraint})$$

$$0 \leq \alpha \leq 1 \quad (\text{Decision variable constraint})$$

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### 0.4 Model 2 : The second model

Find the worst demand matrix with given routing  $\phi$  to maximize maximum link utilization

$\max \rho$  (Maximize minimum link utilization)

$$\sum_{e=(v,u) \in E} \phi_{st}(e) - f_{st}(u) = \begin{cases} 1 & \text{if } u = s \\ -1 & \text{if } u = t, \forall s, t, u \in V \\ 0 & \text{others} \end{cases} \quad (\text{Flow conservation})$$

$$\rho \leq \sum_{(s,t)} \frac{d_{st} f_{st}(u) \phi_{st}(e)}{c(e)} \leq 1 \quad (\text{Link capacity constraint})$$

$$0 \leq \rho \leq 1 \quad (\text{Decision variable constraint})$$

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