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2-Stage Set Partitioning for Dynamic Vehicle Dispatching

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Dynamic Problem

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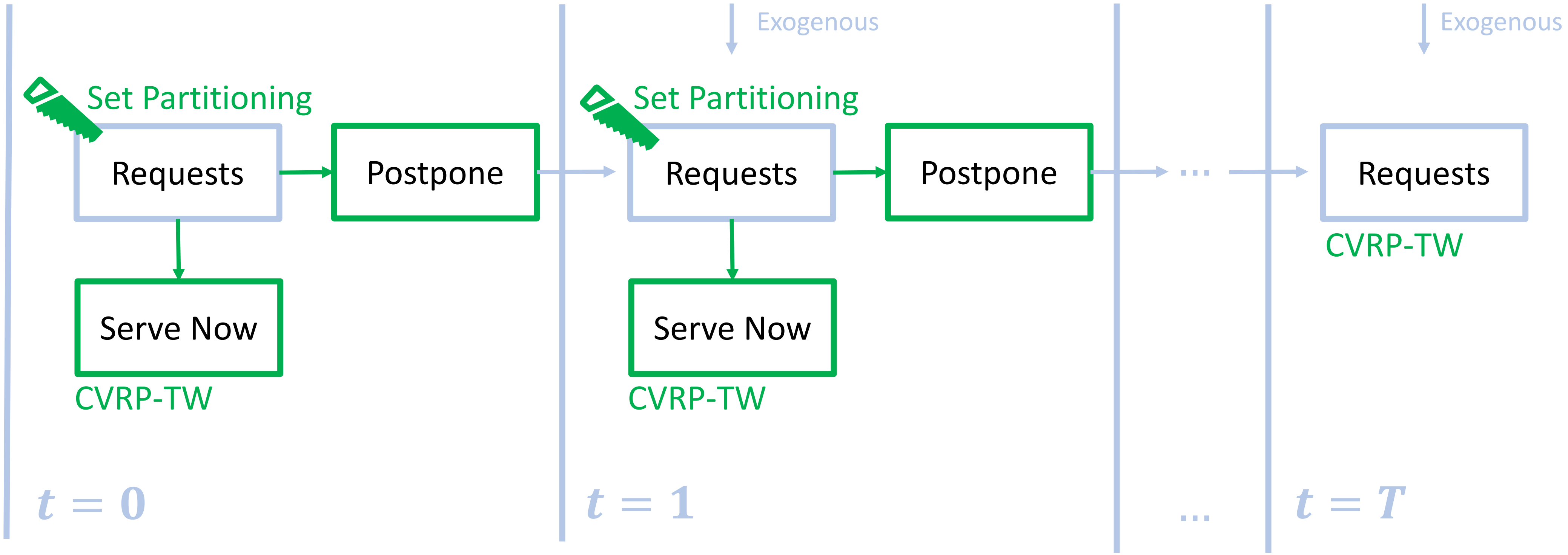

Two Decisions: **partitioning** and **routing**

Optimal Set Partitioning

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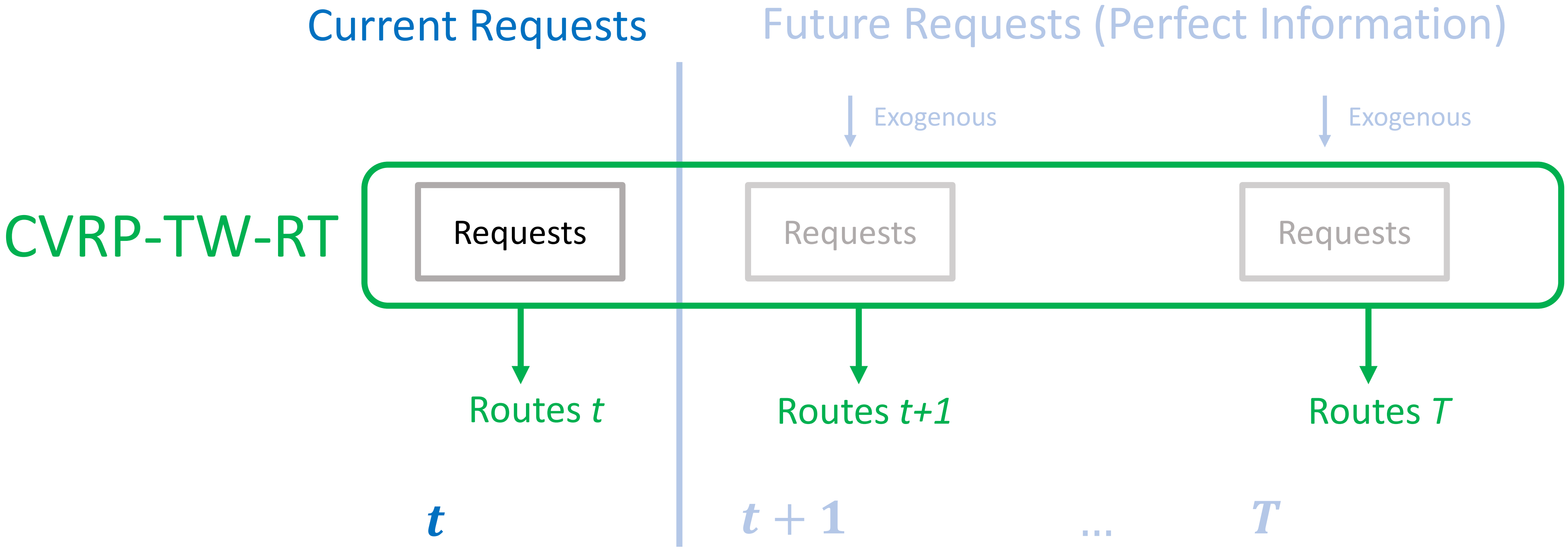
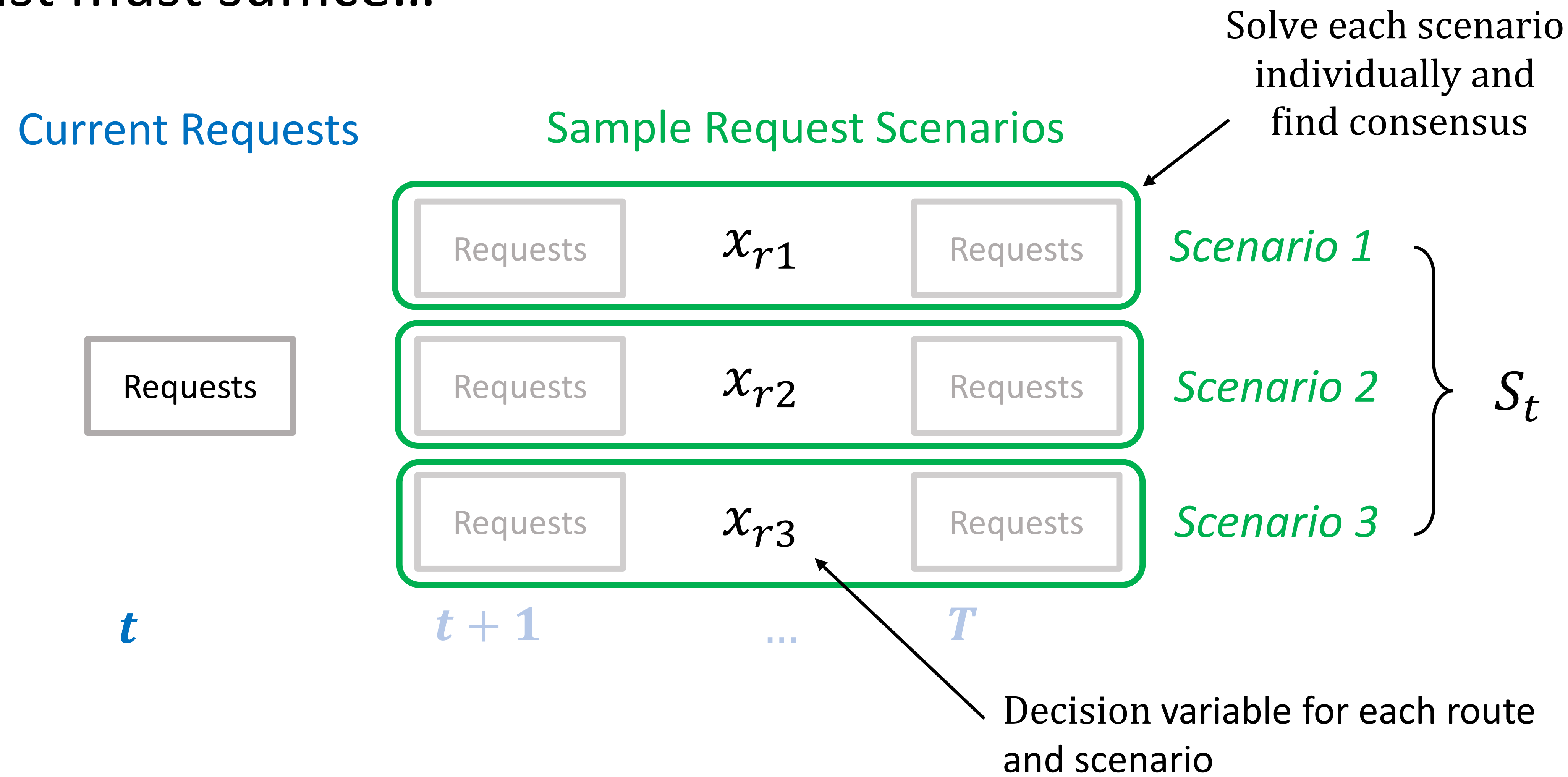
In an ideal world...



2-Stage Set Partitioning

A forecast must suffice…



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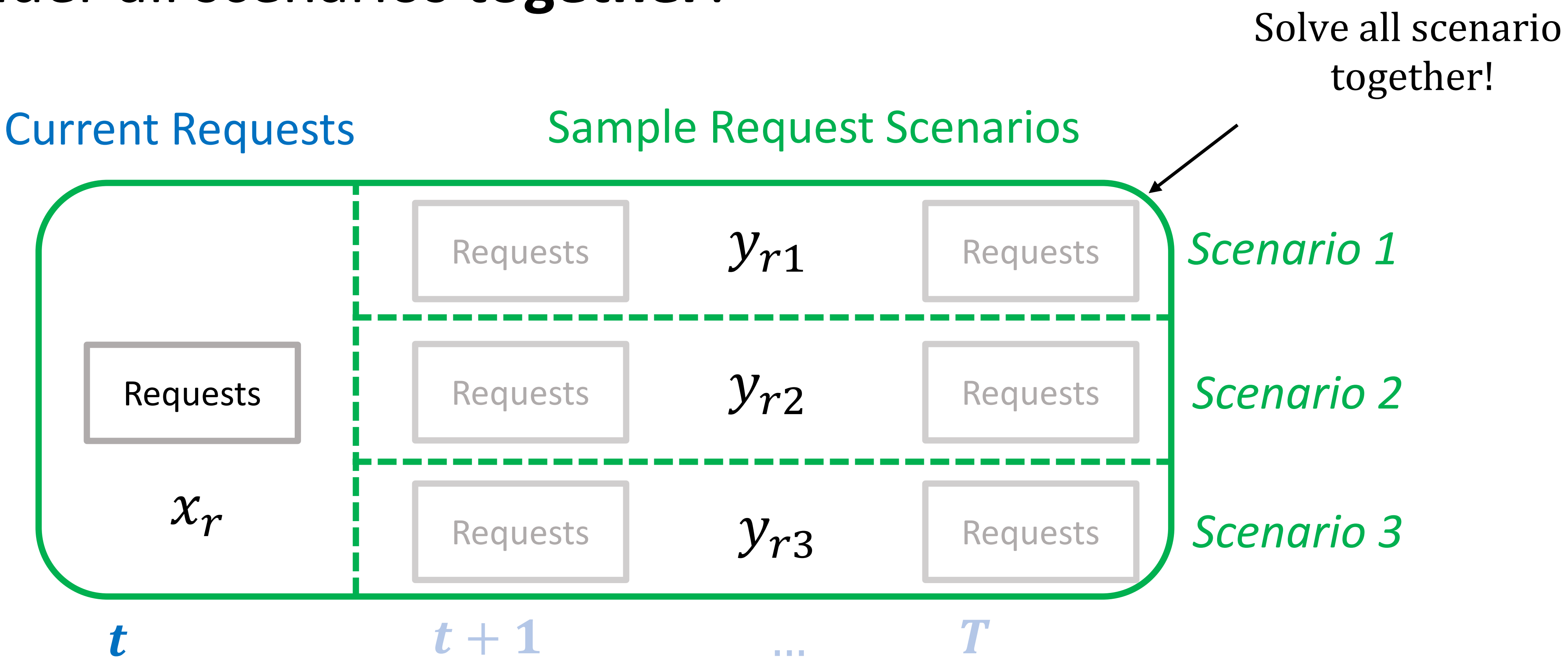
We consider all scenarios **together**!



Key idea:

Served now in **one** scenario → Served now in **all** scenarios
Postponed in **one** scenario → Postponed in **all** scenarios

2-Stage Set Partitioning

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Model and notation:

$$\min \sum_{r \in \mathcal{R}_c} c_r x_r + \frac{1}{|\mathcal{S}_t|} \sum_{j \in \mathcal{S}_t} \sum_{r \in \mathcal{R}_{f,j}} c_r y_{rj}$$

$$\text{s.t.} \sum_{r \in \mathcal{R}_c} a_{ir} x_r + \sum_{r \in \mathcal{R}_{f,j}} a_{ir} y_{rj} = 1 \qquad \forall j \in \mathcal{S}_t, \forall i \in \mathcal{C}_t \cup \mathcal{C}_{tj}$$

$$x_r \in \{0,1\} \qquad \forall r \in \mathcal{R}_c$$

$$y_{rj} \in \{0,1\} \qquad \forall j \in \mathcal{S}_t, \forall r \in \mathcal{R}_{f,j}$$

S_t	Set of sampled scenarios
C_t	Current requests
C_{tj}	Requests sampled in Scenario j
R_c	Set of feasible routes for current epoch
R_{fj}	Set of feasible routes to deploy in the future assuming scenario j
c_r	Costs of route $r \in R_c \cup_{j \in S_t} R_{fj}$
a_{ir}	Customer i is served in route r
x_r	Route $r \in R_c$ is deployed
y_{rj}	Route $r \in R_{fj}$ is deployed

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Challenges and **solutions**

Combinatorial Number of decision variables → Column Generation

Pricing out routes is NP-hard → Relax elementarity of routes (generate *(q-t)*-routes via dynamic programming)

What we get: Dual bound on marginal cost of serving requests now vs later

Finally: Partition current requests accordingly and solve CVRP-TW

Closing Remarks

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Thank you to the organizers!

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