

# Survivable Network Design for Group Connectivity in Bounded-Treewidth Graphs

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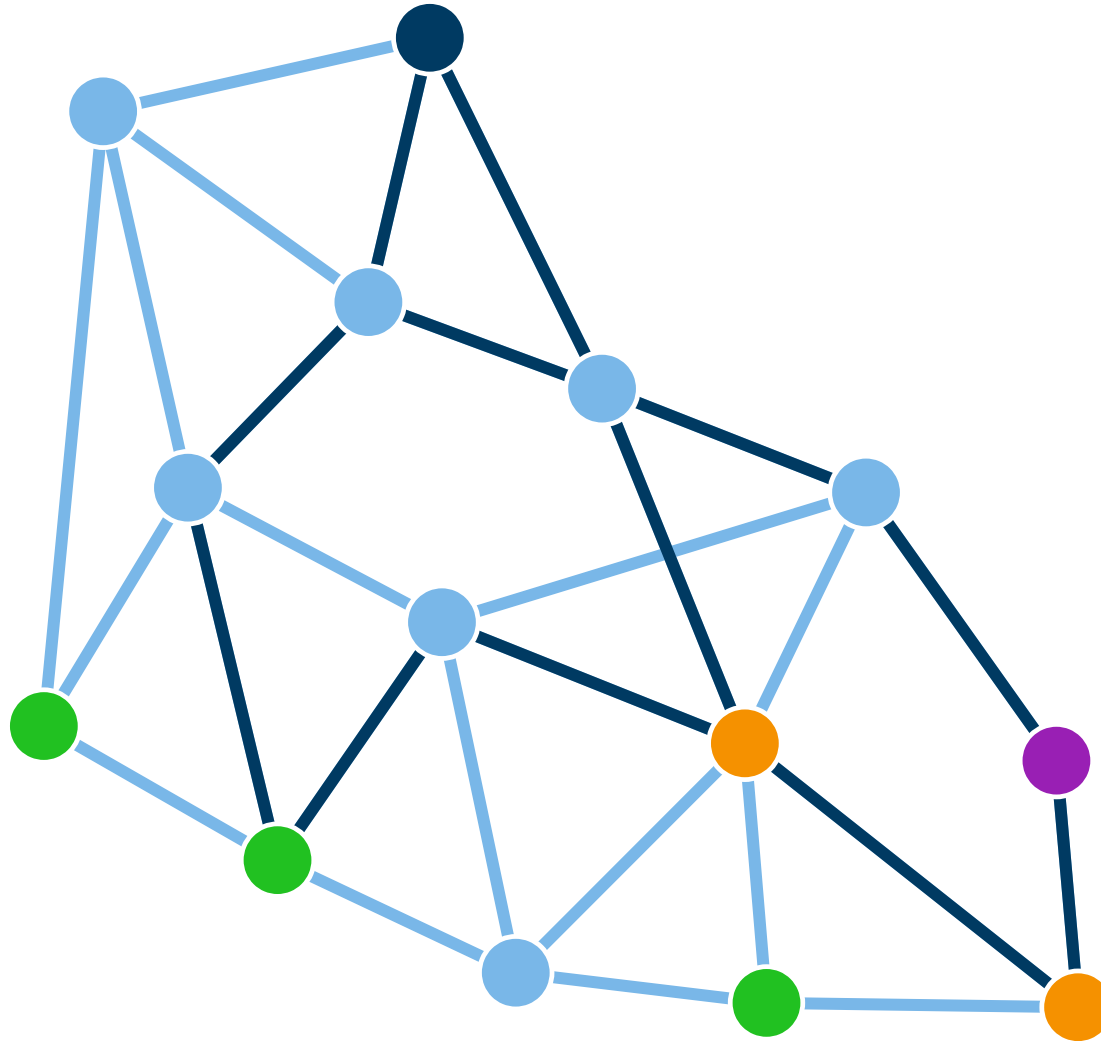
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# Group SNDP



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- Input:
  - Graph  $G$ , edge/vertex costs
  - Groups  $S_i$  with connectivity demands  $k_i$
  - Root  $r$
- Goal: Find a min-cost graph that
  - Contains  $k_i$  disjoint paths from  $r$  to  $v_i \in S_i$

# Known Results

- $k_i = 1$ : Group Steiner Tree
  - $O(\log^3 n)$ -approx\*,  $O(\log^2 n)$ -hardness [GKR'98], [HK'03]
  - Bounded Treewidth:  $O(\log^2 n)$ -approx [CDLV17']
- $k_i \leq 2$ 
  - $\tilde{O}(\log^4 n)$ -approx\* [GKR'10]
- \* **Cannot be improved beyond  $O(\log n)$** 
  - Both use tree embedding, which has distortion  $\Omega \log n$

# Known Results

- Groups of size 1: SNDP
  - 2-approx [Jain'00]
- In general: Label-Cover hard [KKN'12]
  - $2^{\log^{1-\epsilon} n}$  hardness
  - $\Omega(n^\delta)$  hardness under Sliding Scale Conjecture

# Our Results

- Group SNDP:
  - $O(\log^2 n)$ -approx in  $n^{f(k, tw(G))}$
- SNDP:
  - Exact algorithm in time  $n2^{f(k, tw(G))}$
- Both results for vertex weights / connectivity

# Main Idea

- Develop a DP without group constraints
- Turn the DP into an LP and add the group constraints
- New LP represents a variant of Group Steiner Tree

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## Fine-Grained Complexity and Algorithms



**Ramamohan Paturi**

UC San Diego

Foundations of Fine-grained Complexity



**Amir Abboud**

IBM Almaden

Hardness in P



**Danupon Nanongkai**

KTH

Dynamic graphs: algorithms,  
conditional lower bounds,  
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