Survivable Network Design for Group Connectivity in Low-Treewidth Graphs

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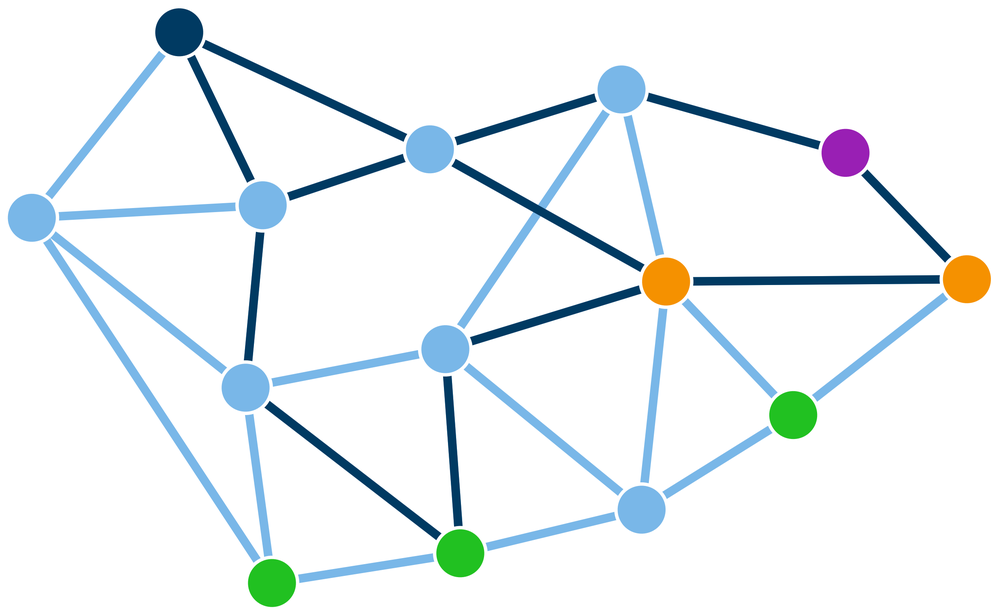
SNDP with Group Constraints



Goal: k-connect a vertex from each group

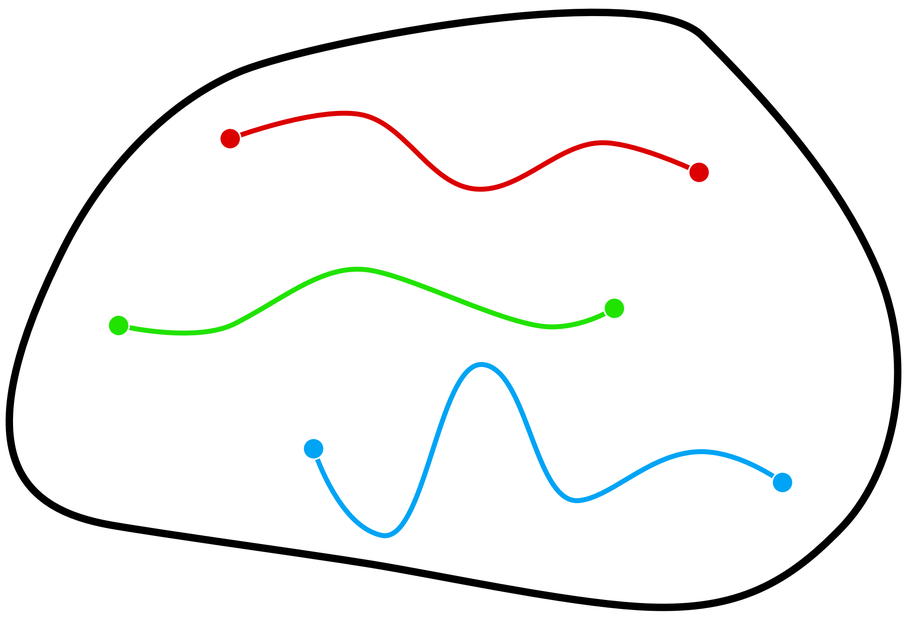
Known Results

	Apx. Ratio	Hardness
$k = 1$ (GST)*	$O(\log^2 n \log h)$ [GKR'98]	$O(\log^{2-\epsilon} h)$ [HK'03]
$k = 1$ (low TW)	$O(\log n \log h)$ [**CDLV**'17]	$O(\log^{2-\epsilon} h)$
$k = 2$ *	$\tilde{O}(\log^4 n)$ [GKR'10]	
Non-Group	2 [Jain'00]	APX-hard [CC'08]
General		$2^{\log^{1-\epsilon} n}$ [KKN'12]

$*$ **Cannot be improved beyond** $O(\log^3 n)$
(both use tree embedding, which has distortion $\Omega(\log n)$)

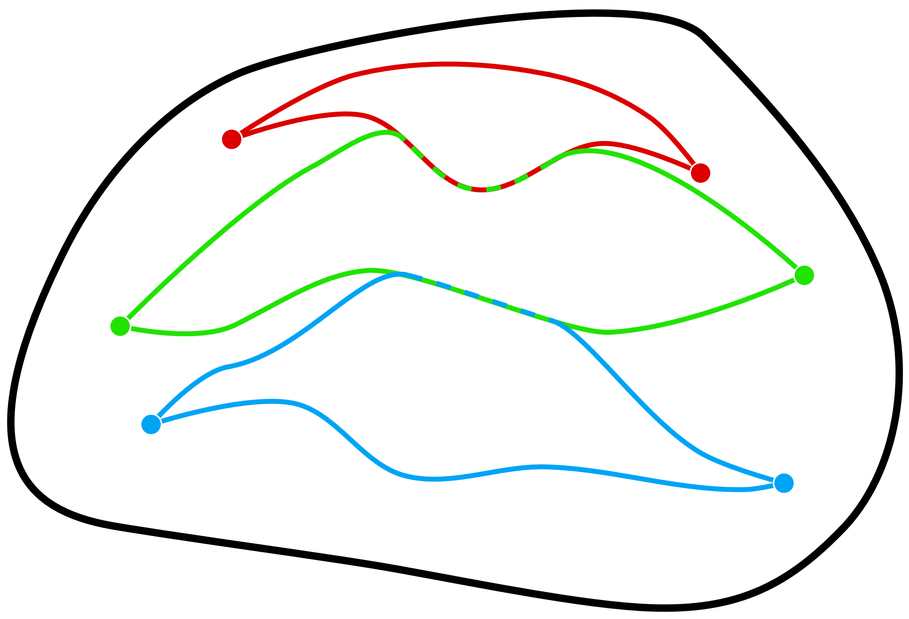
Similar Problem: Edge Disjoint Paths

Standard approach: Use DP to partition edges



Group SNDP

Two commodities can share the same edges.
DP / Partitions do not work.



Our Results

- Group SNDP: $O(\log n \log h)$-approximation
  - Running time: $n^{f(k,tw(G))}$
- SNDP (groups of size 1)
  - Running time: $n2^{f(k,tw(G))}$
- Generalizable framework for group problems
  - Also works for vertex weights

Main Ideas

- Write **DP for non-group problem**
  - Consider connectivity for different partitions
  - Each DP state connects some terminals
- Solve **LP to get DP-like solution**
  - With **group constraints** on DP states

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