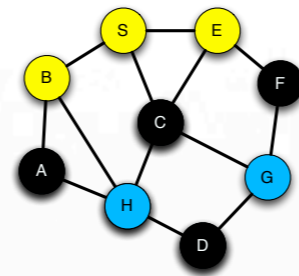




An Improved Greedy Construction of Minimum Connected Dominating Sets in Wireless Networks



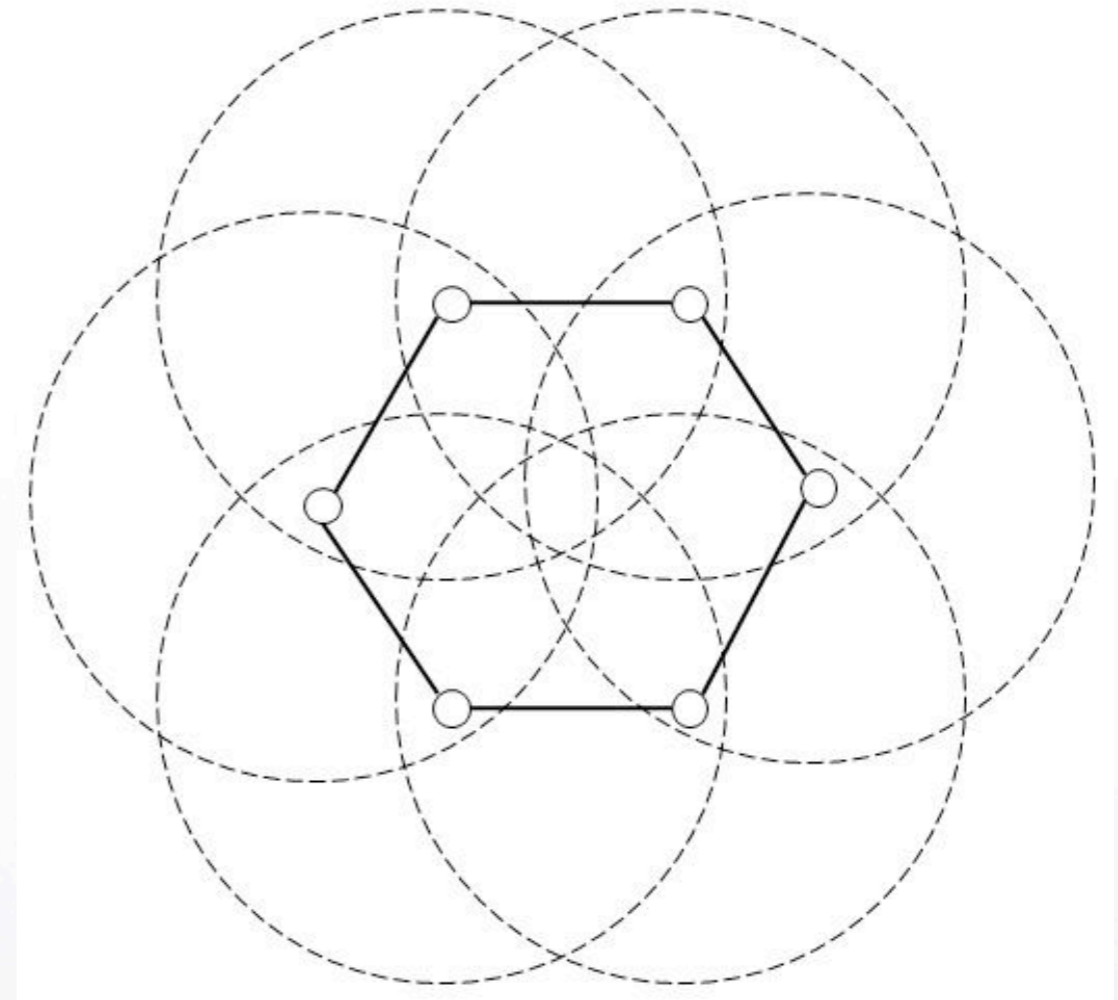
WCNC, 28th March, 2011



Context: Ad Hoc Wireless Networks

- Wireless ad hoc and sensor networks are used widely (health-care industry, food industry, agriculture, military,..)
- They consist of static/mobile nodes (hosts) with no fixed backbone infrastructure, communicating over shared medium via single or multiple hops.

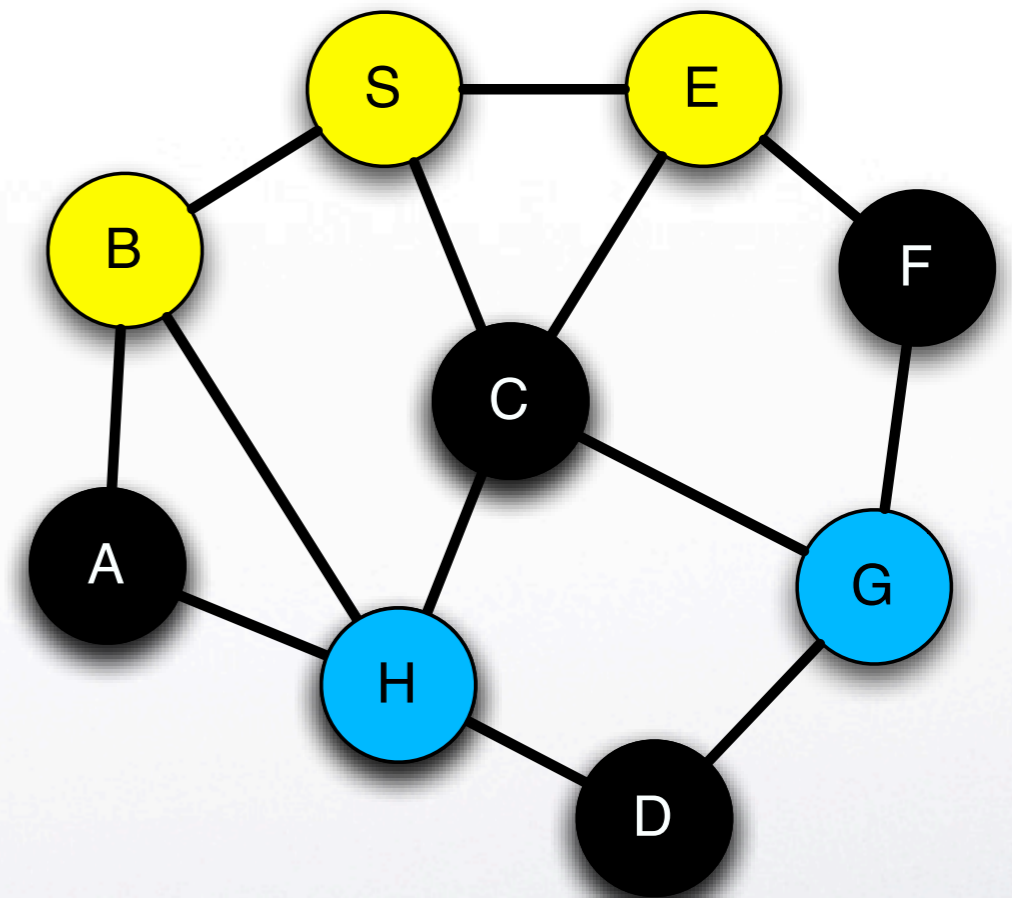
- Representation as a graph
- Node A is connected to node B if and only if A lies within a 'unit' disc centered on B (unit = transmission range)



We are interested in multi-hop routing through a virtual backbone



- **(DS) Dominating Set =**
A subset of nodes such that every node in the network is in or adjacent to a node in the set
(● form a DS)
- **(CDS) Connected Dominating Set**
(● + ● form a CDS)



CDS - a candidate for backbone



The Problem

- A small CDS or minimum CDS (MCDS) is good
 - Routing mostly by CDS
= less transmission interference and communications overhead
 - CDS nodes maintain routing information so less storage space
 - Convergence speed and network management simplified
- But
 - Computing Minimum CDS is an NP-Complete Problem
 - No global information - decentralised control
- So need distributed approximation algorithm for CDS



Related Work

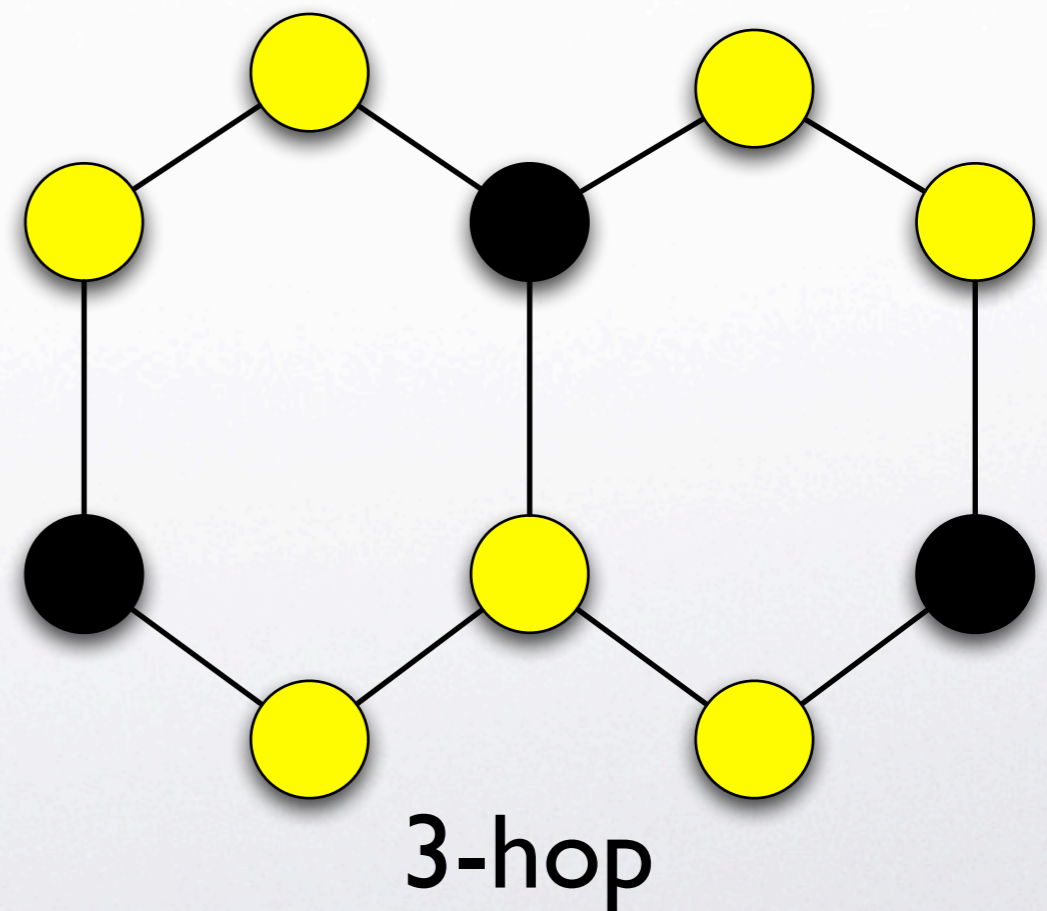
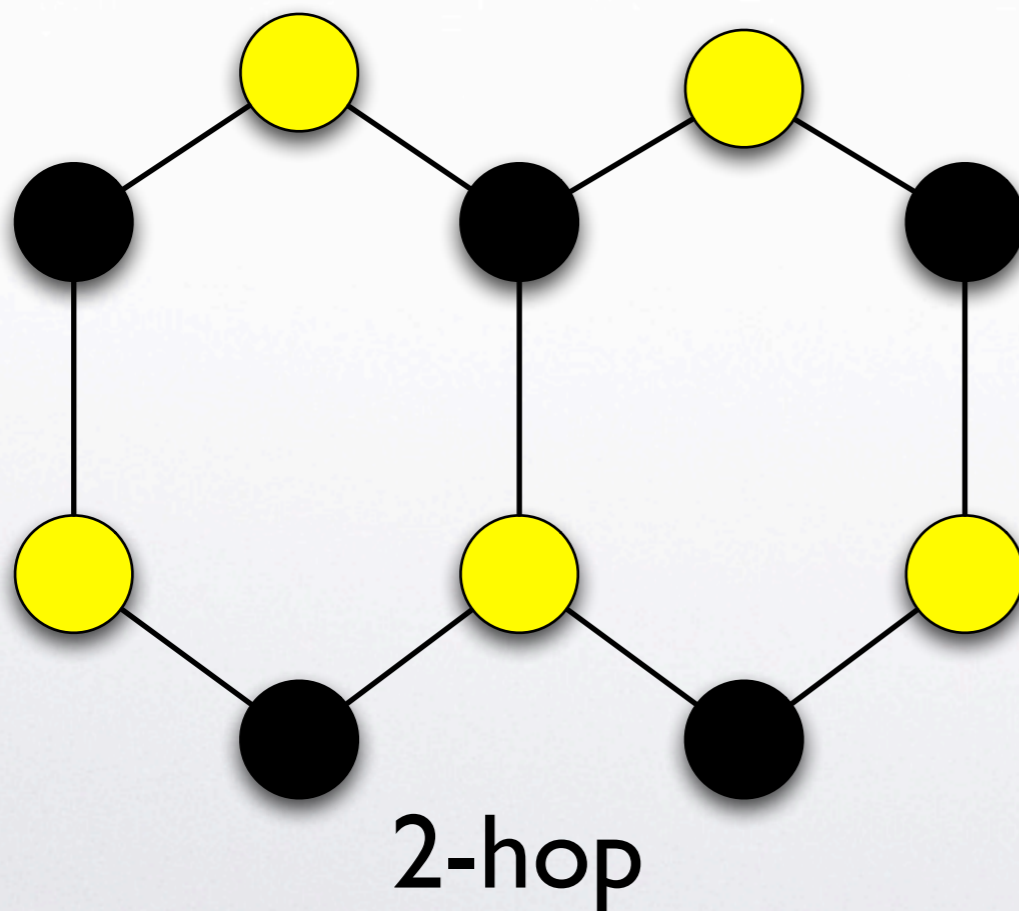
Distributed approaches use two-phase construction of CDS

1. Find a **Maximal Independent Dominating Set**
 - no two nodes in the set are adjacent
 - constructed by looking at two-hop neighbours.
2. Add sufficient dominatees to connect up a single component (connectors)



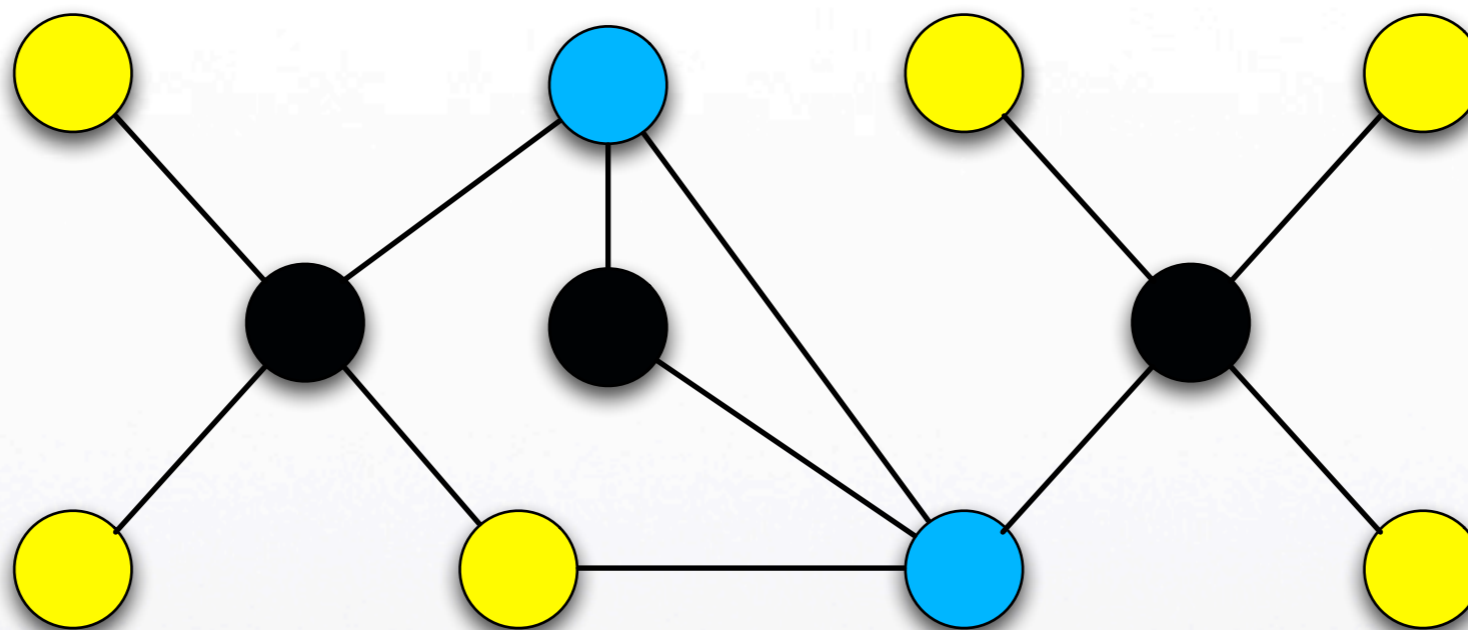
Our Contribution

Firstly, a smaller Independent Dominating Set is constructed using 3-hop neighbours





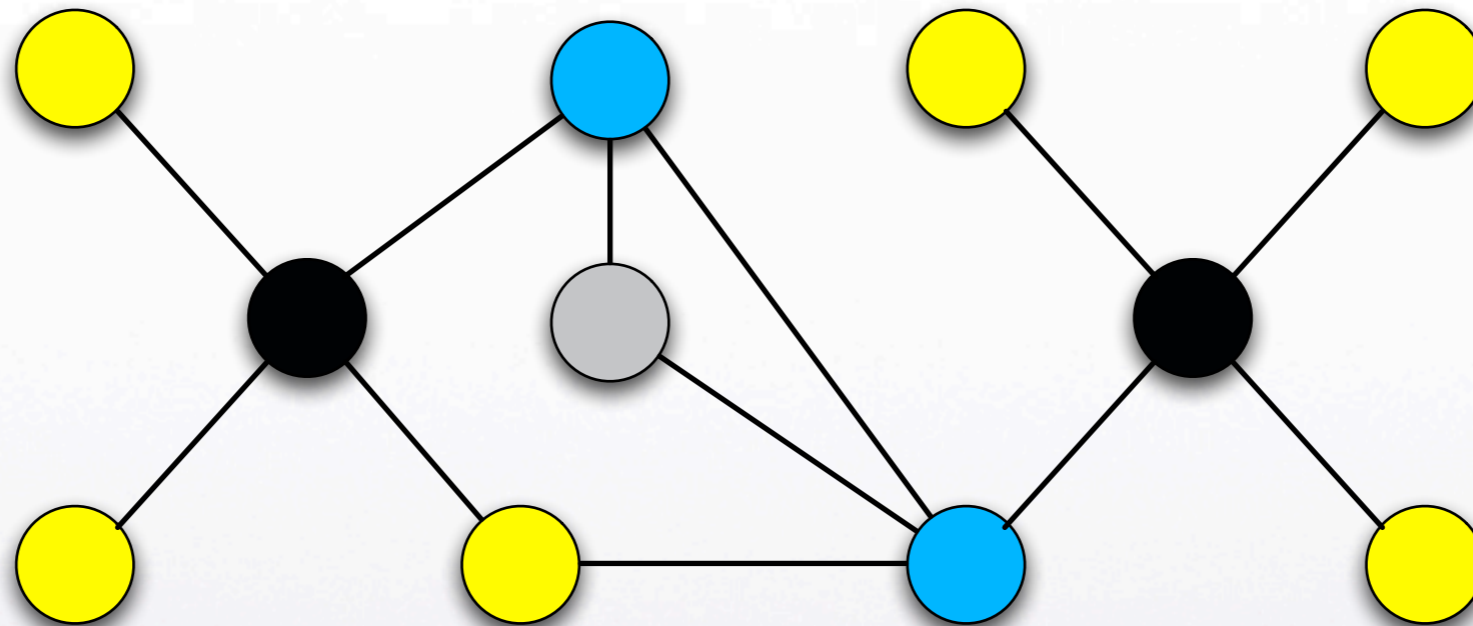
Secondly, we allow for downgrading dominators to dominatees as the Independent Dominating Set is connected



The dominating set (black nodes) are connected up using two connectors (blue nodes). But then the middle black node is no longer needed as a dominator.



I.e. we use a **Pseudo Dominating Set (PDS)**
for the Steiner tree construction of CDS

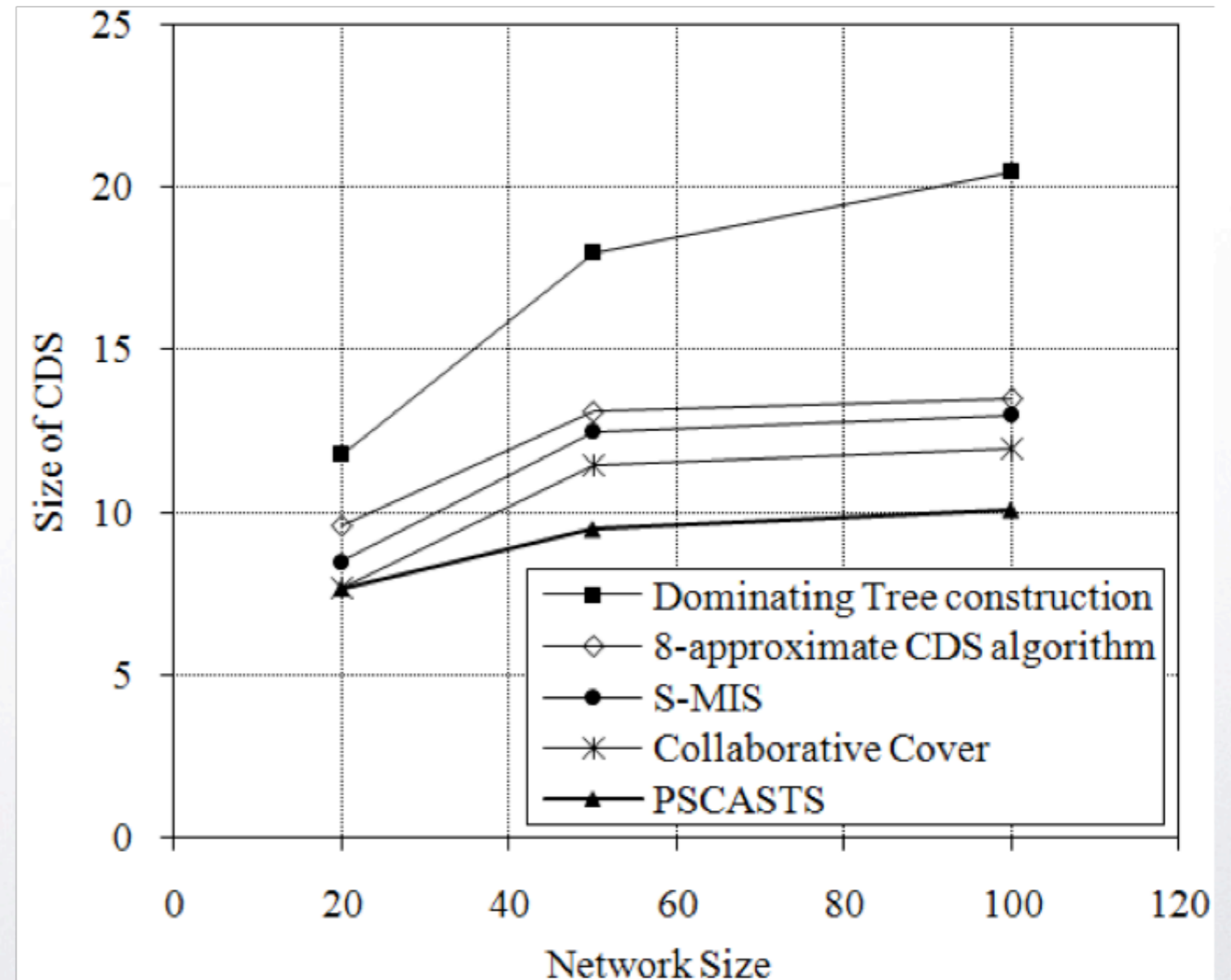


The grey node becomes a dominatee.



Some comparisons

PSCASTS
Pseudo-
Dominating
Set
Construction
and Steiner
Tree Spanning





Salient features of our algorithm

PSCASTS

- PDS construction identifying smaller MISs
- Improved Steiner tree construction selectively removing unnecessary dominators
- Multiple-Leader based distributed algorithm with time complexity of $O(D)$ ($D = \text{Network diameter}$)
- Identifies non-trivial, smaller CDSs even when the distribution of sensor nodes is uniform or nearly-uniform.