On the Structure of Changes in Dynamic Contact Networks

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Outline

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Dynamic Contact Networks

Participants carry sensor devices

- send periodically
- listen at any time
- log received signals

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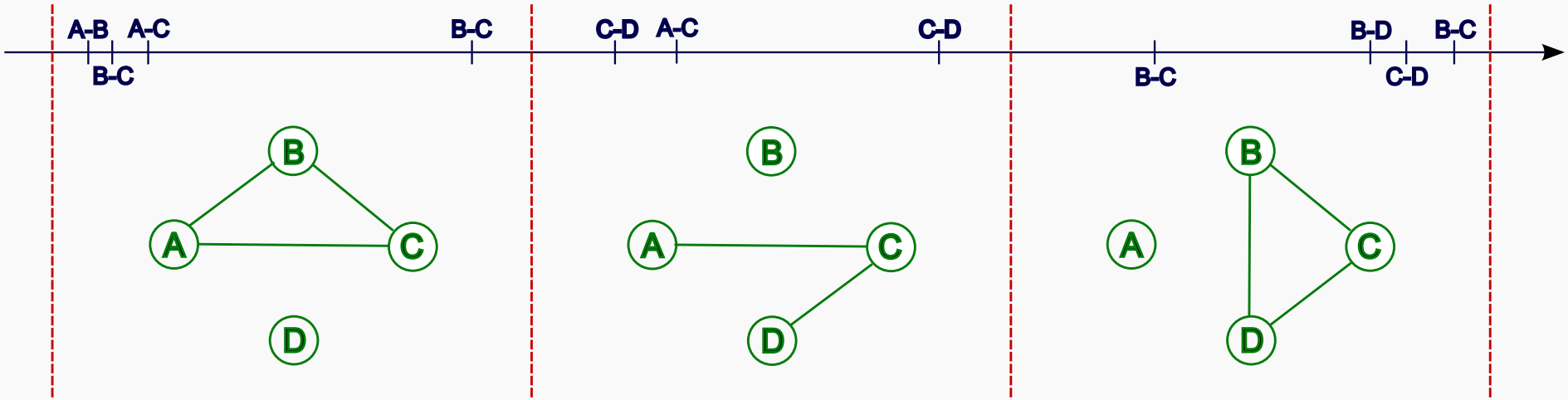
Aggregation of contacts: series of contacts $\rightarrow$ series of graphs



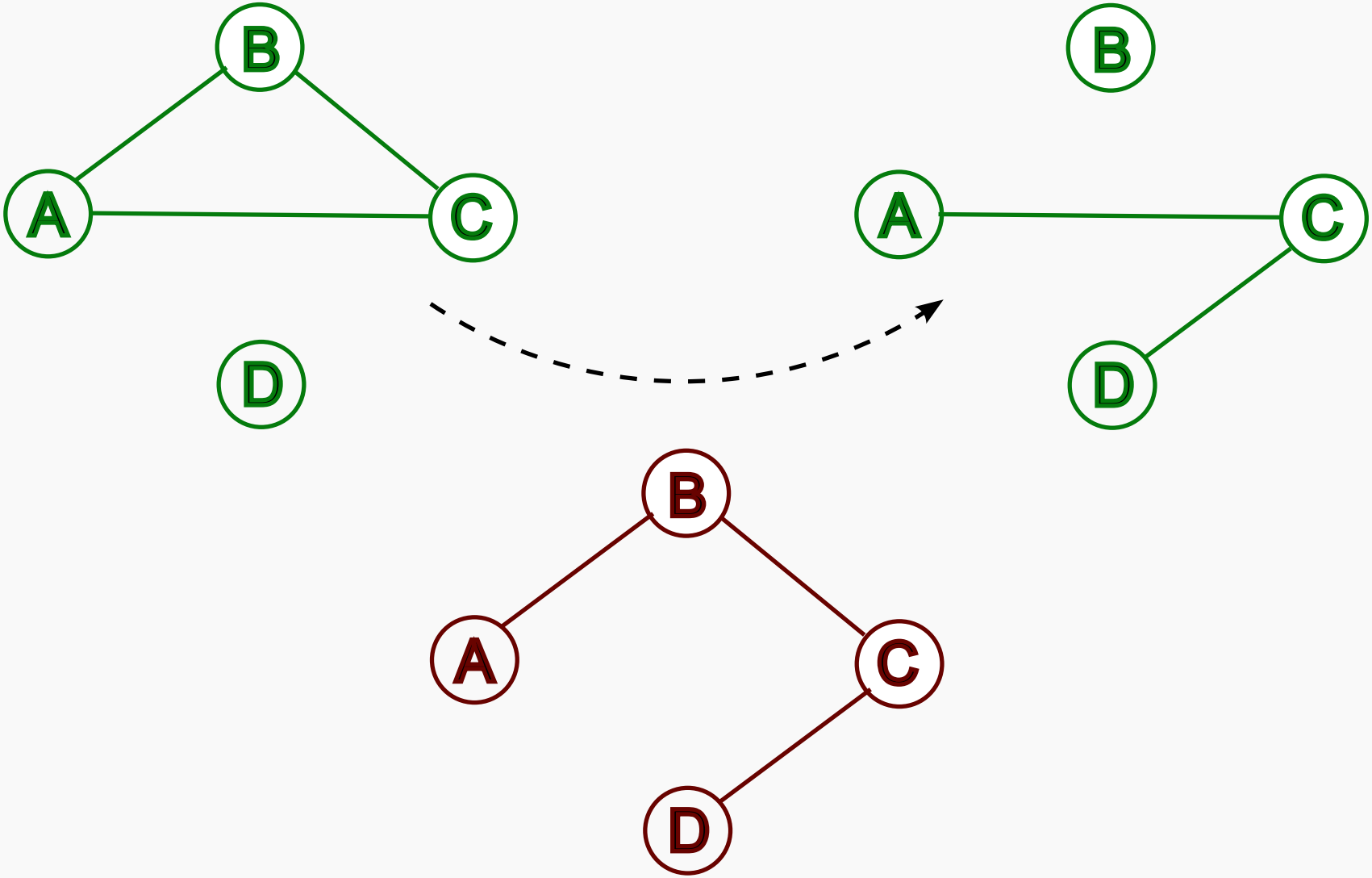
Our goal

Correlation between consecutive graphs

Structure of changes: concentrated or spread?

Suitable object: difference graph

Difference graphs



Generality of our approach

Approach purely graph-based

- proximity contacts
- communications
- online social networks

No use of mobility data

- not always available
- not always relevant
- we study contacts

Outline

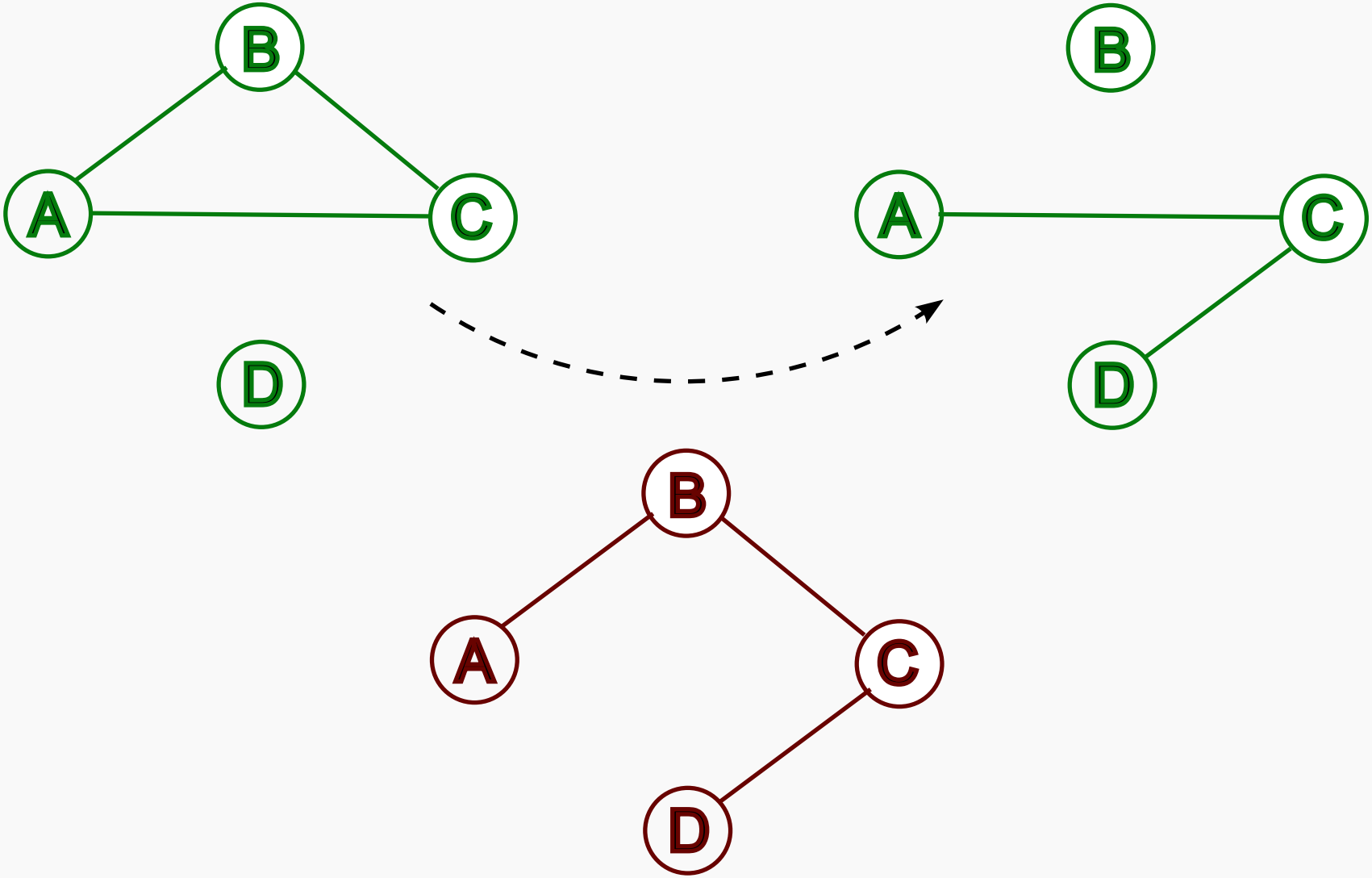
Structure of changes

$\rightarrow$ Concentration of edges in the difference graphs

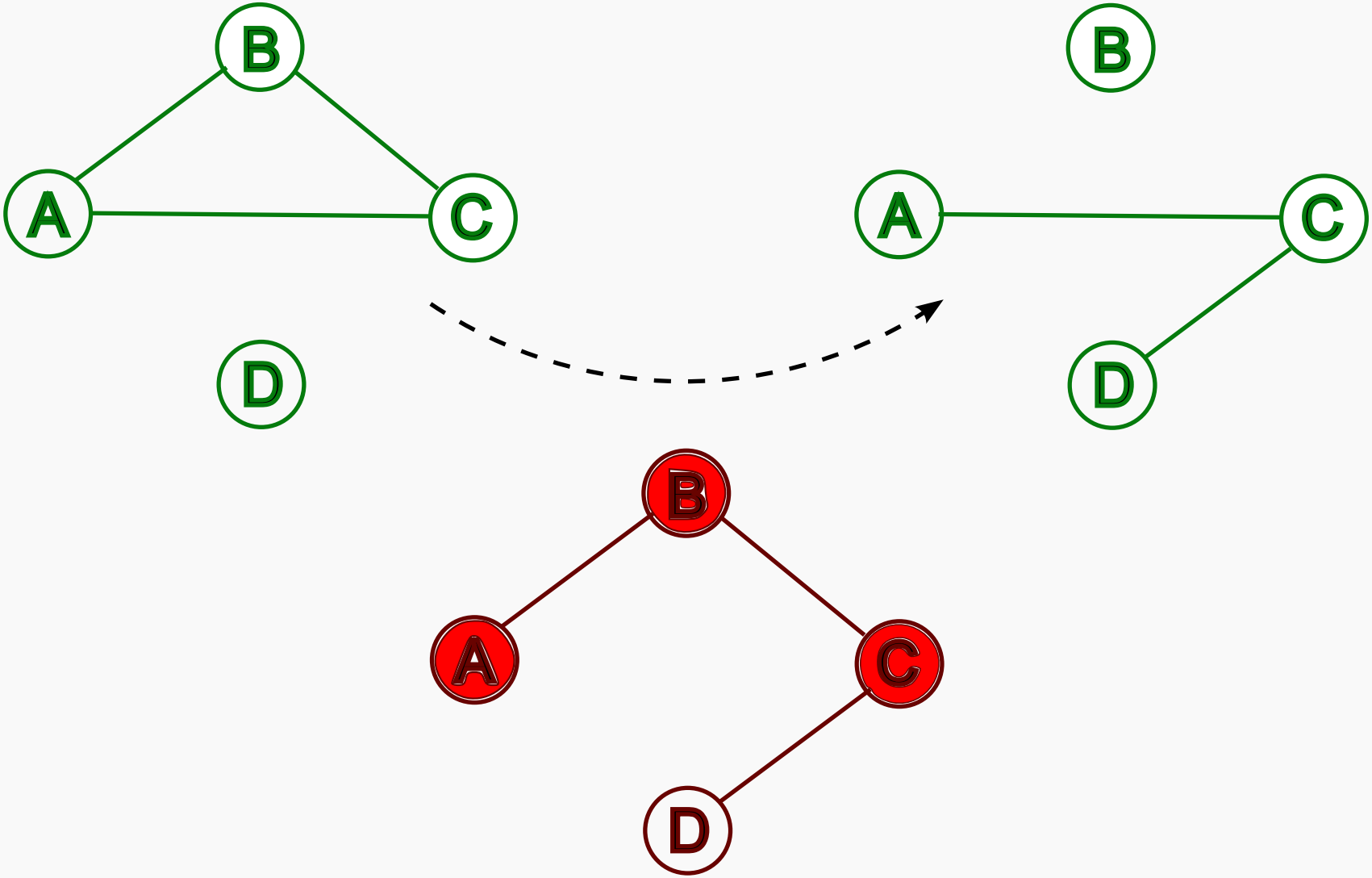
Two parameters:

- non-isolated nodes
  $\Rightarrow$ nodes involved in changes
- minimum vertex cover
  $\Rightarrow$ nodes that concentrate changes

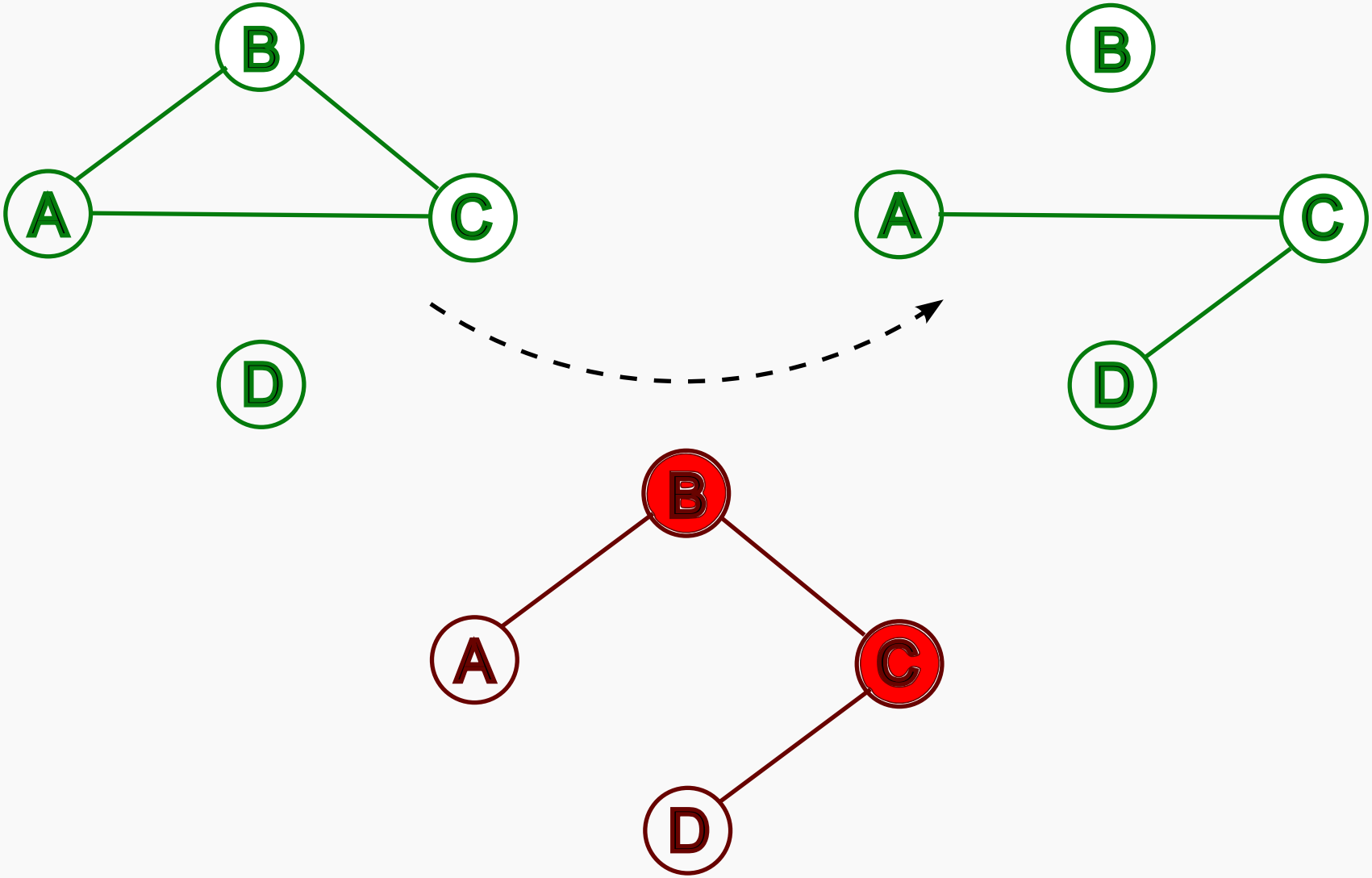
Minimum Vertex Cover



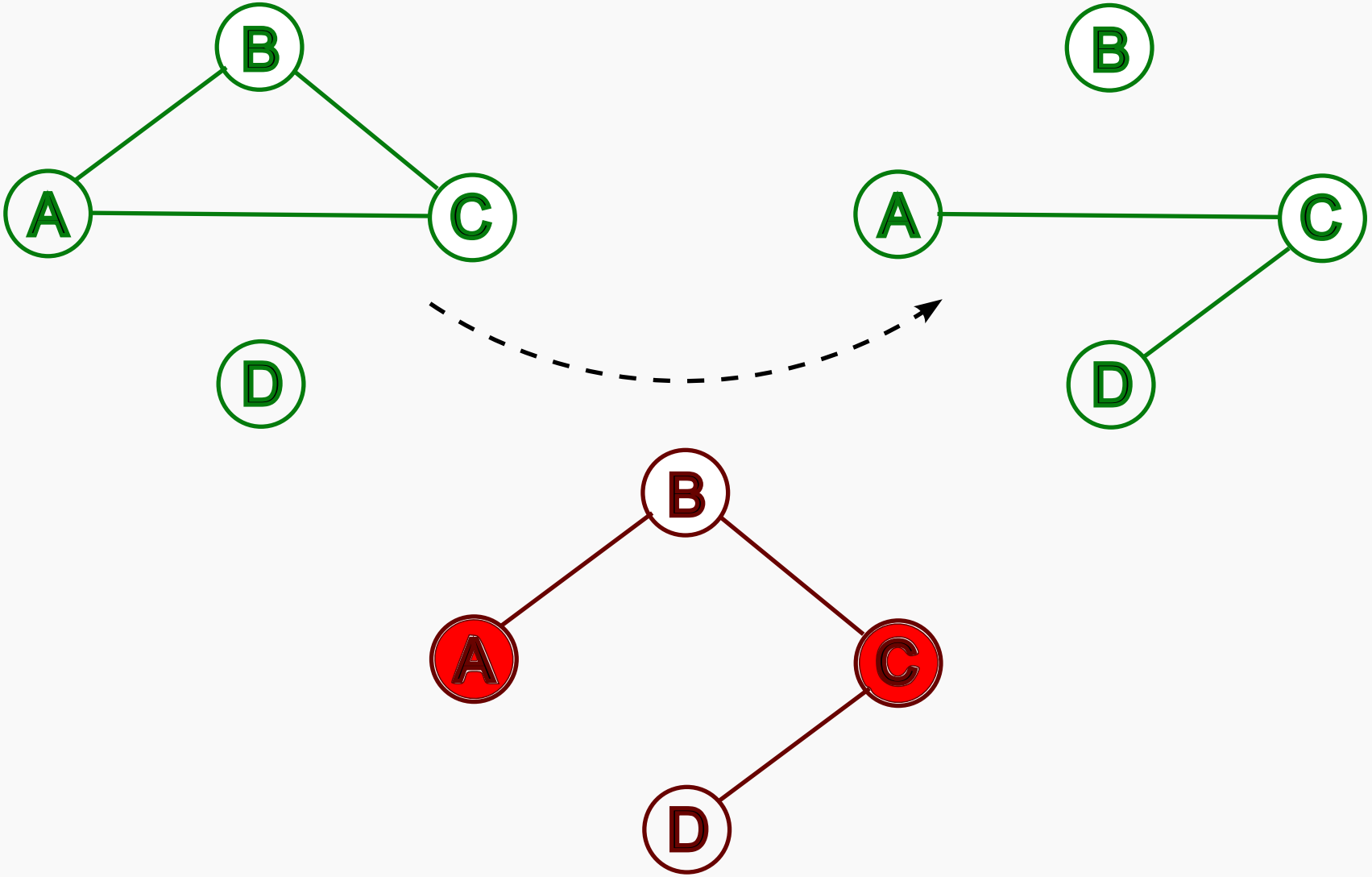
Minimum Vertex Cover



Minimum Vertex Cover



Minimum Vertex Cover



Structure of changes (continued)

→ Concentration of edges in the difference graphs

Two parameters:

- non-isolated nodes
  ⇒ nodes involved in changes
- minimum vertex cover
  ⇒ nodes that concentrate changes

Comparison: actual values / expected values

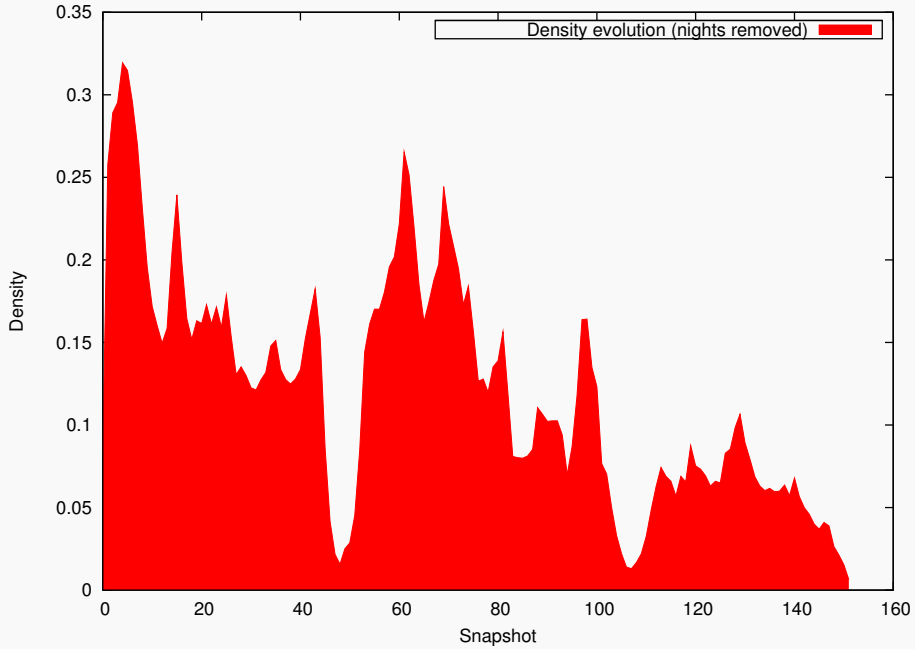
Random graph of given density: Erdös-Rényi model.

Outline

Example dataset: Infocom'06

Proximity contacts

Sampling period: 120 seconds
Chosen aggregation period: 900 seconds

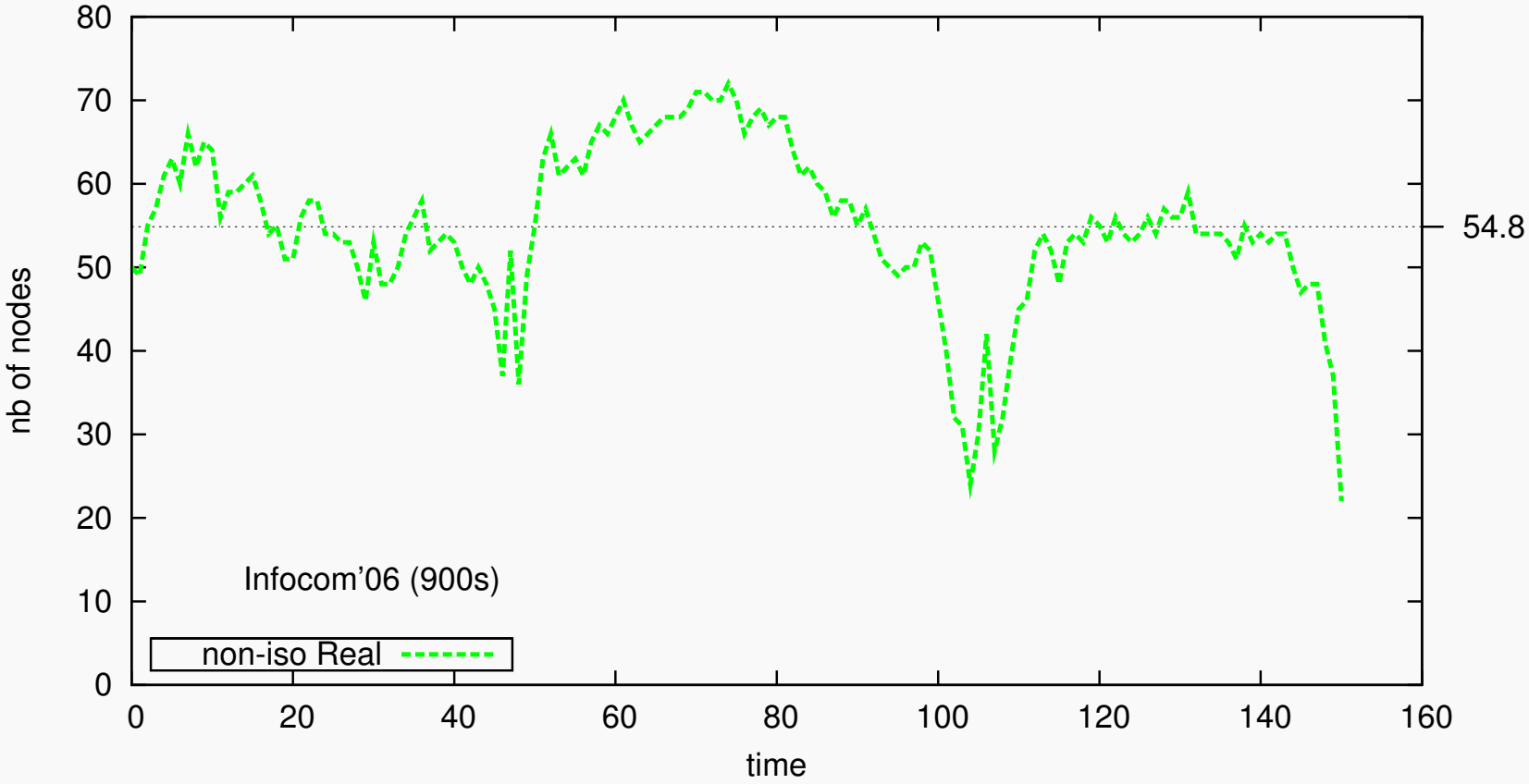


Other datasets: Infocom'05, RollerNet, Cambridge, MOSAR

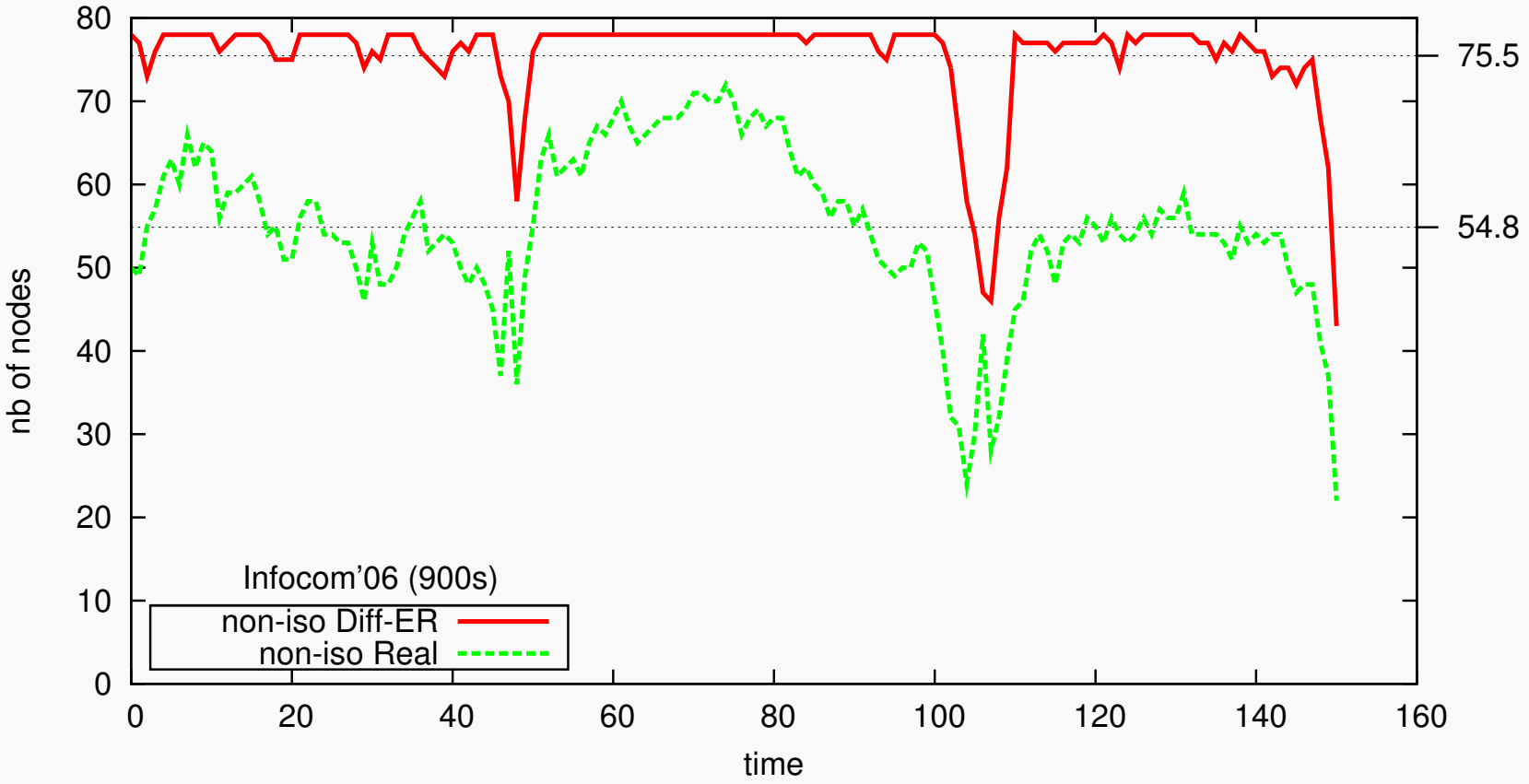
Results

Parameters

Non-isolated nodes

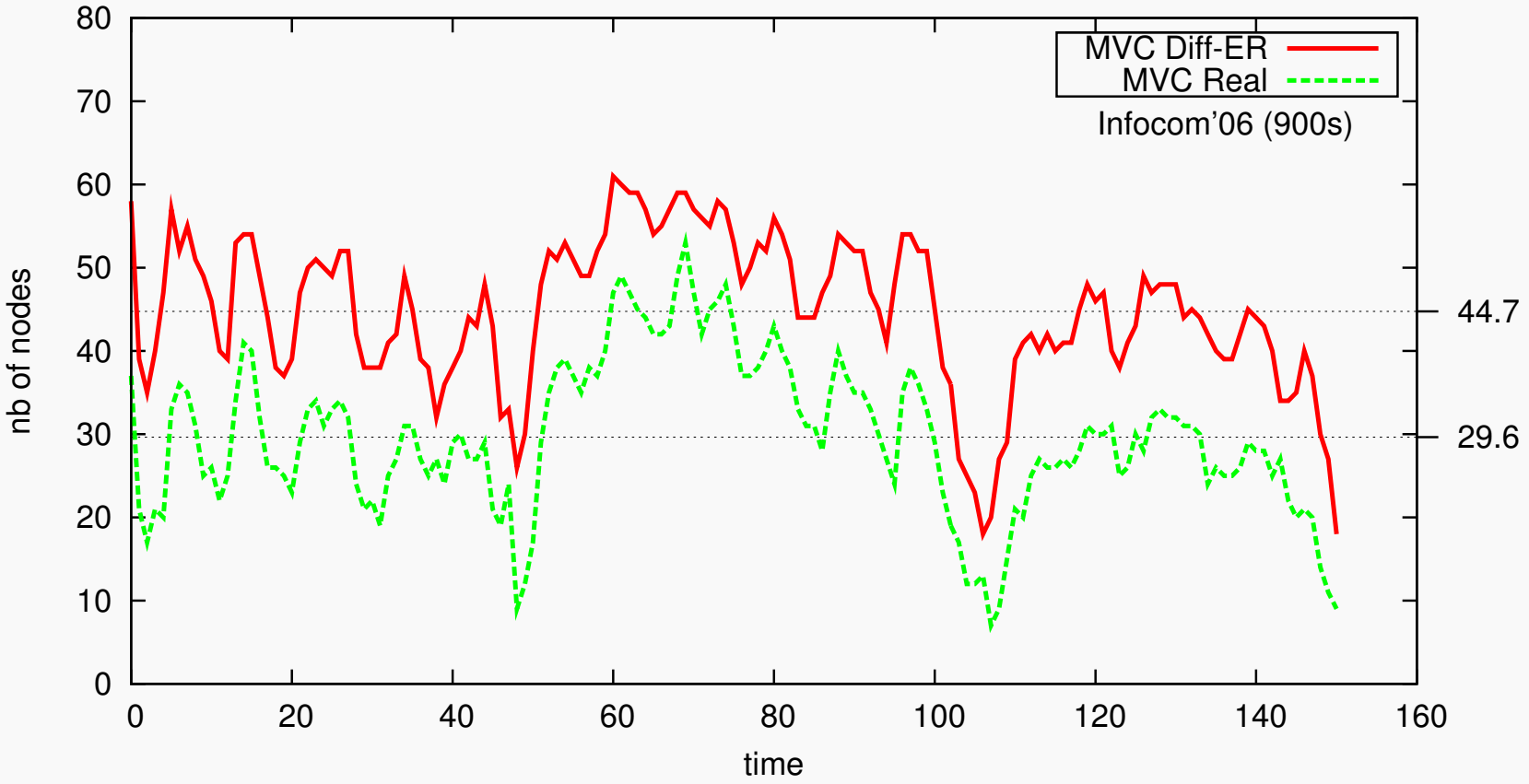


Non-isolated nodes



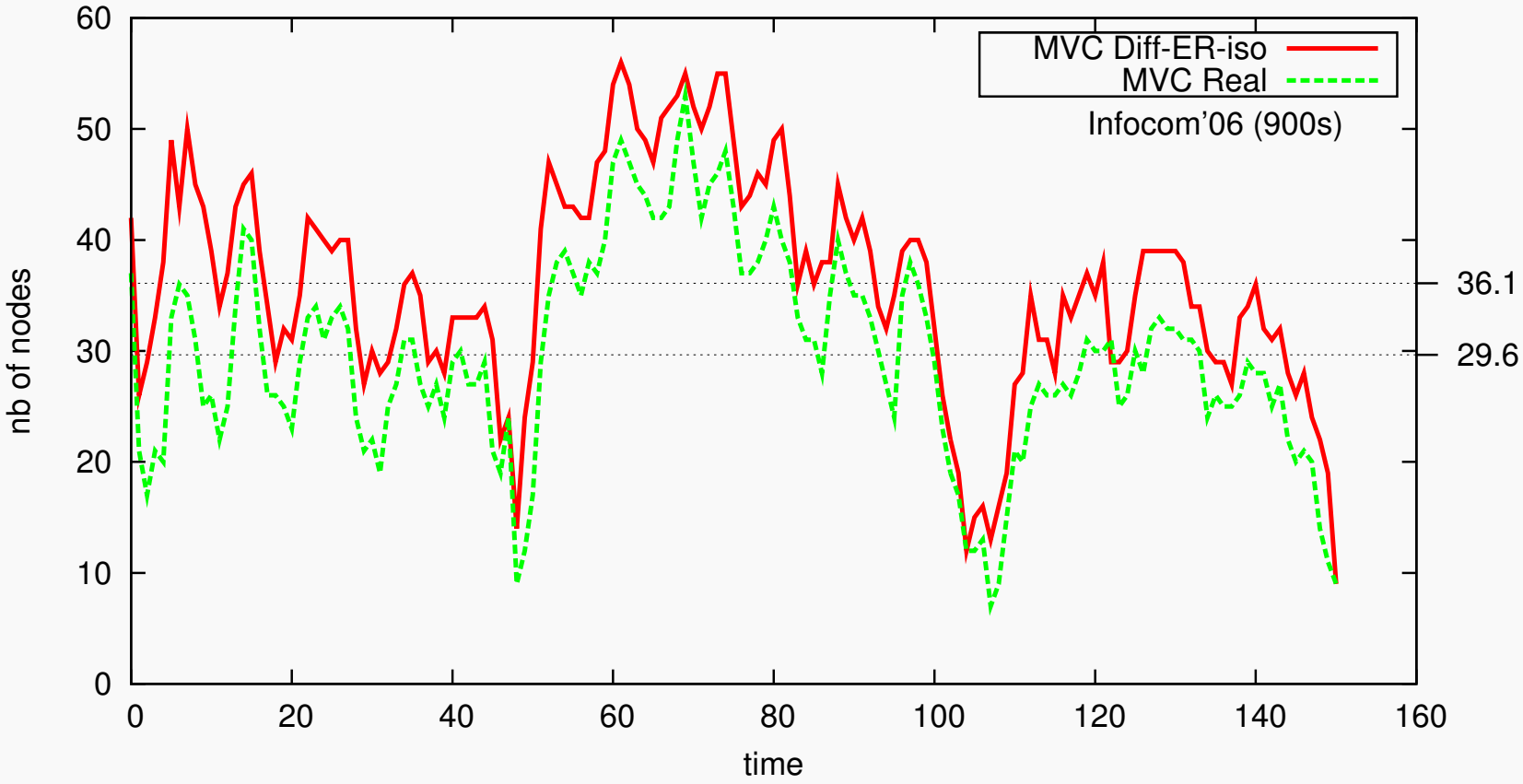
Conclusion: few nodes involved in changes

Minimum Vertex Cover



Conclusion: few nodes concentrate change

Not directly linked



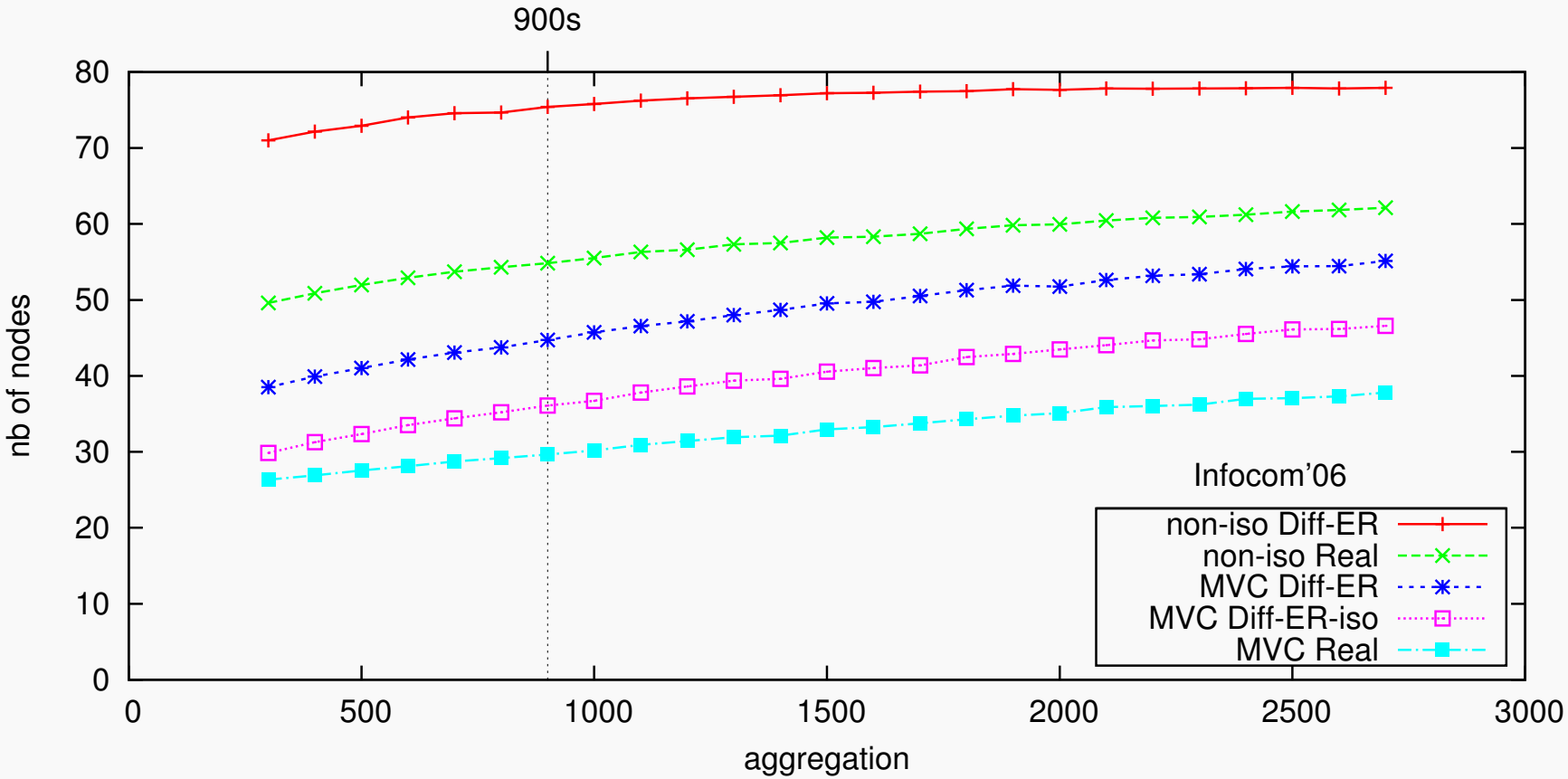
Conclusion: MVC actually smaller than expected

Results

Parameters

Aggregation

Influence of the aggregation period



Conclusion: wide range of aggregation periods

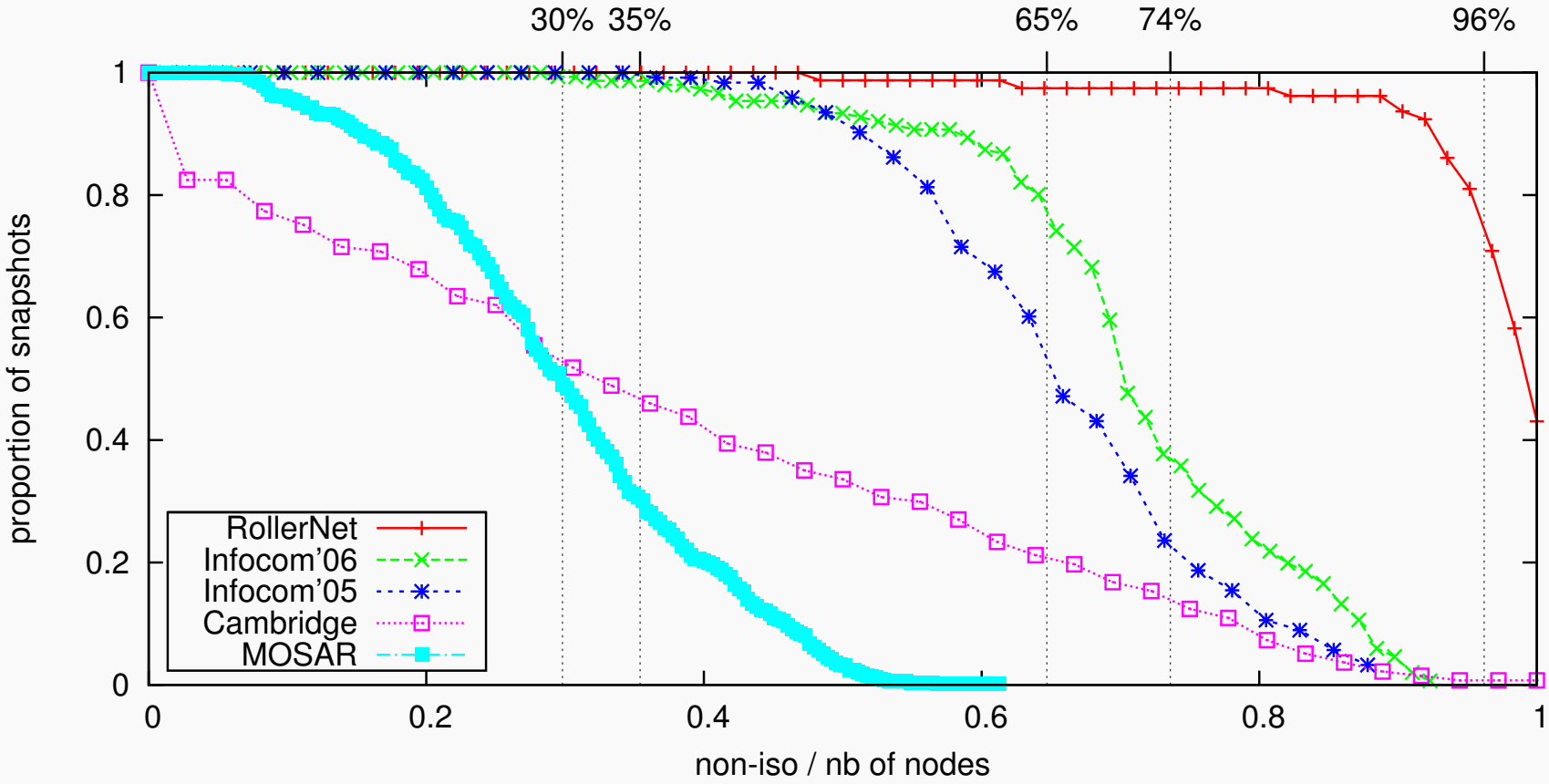
Results

Parameters

Aggregation

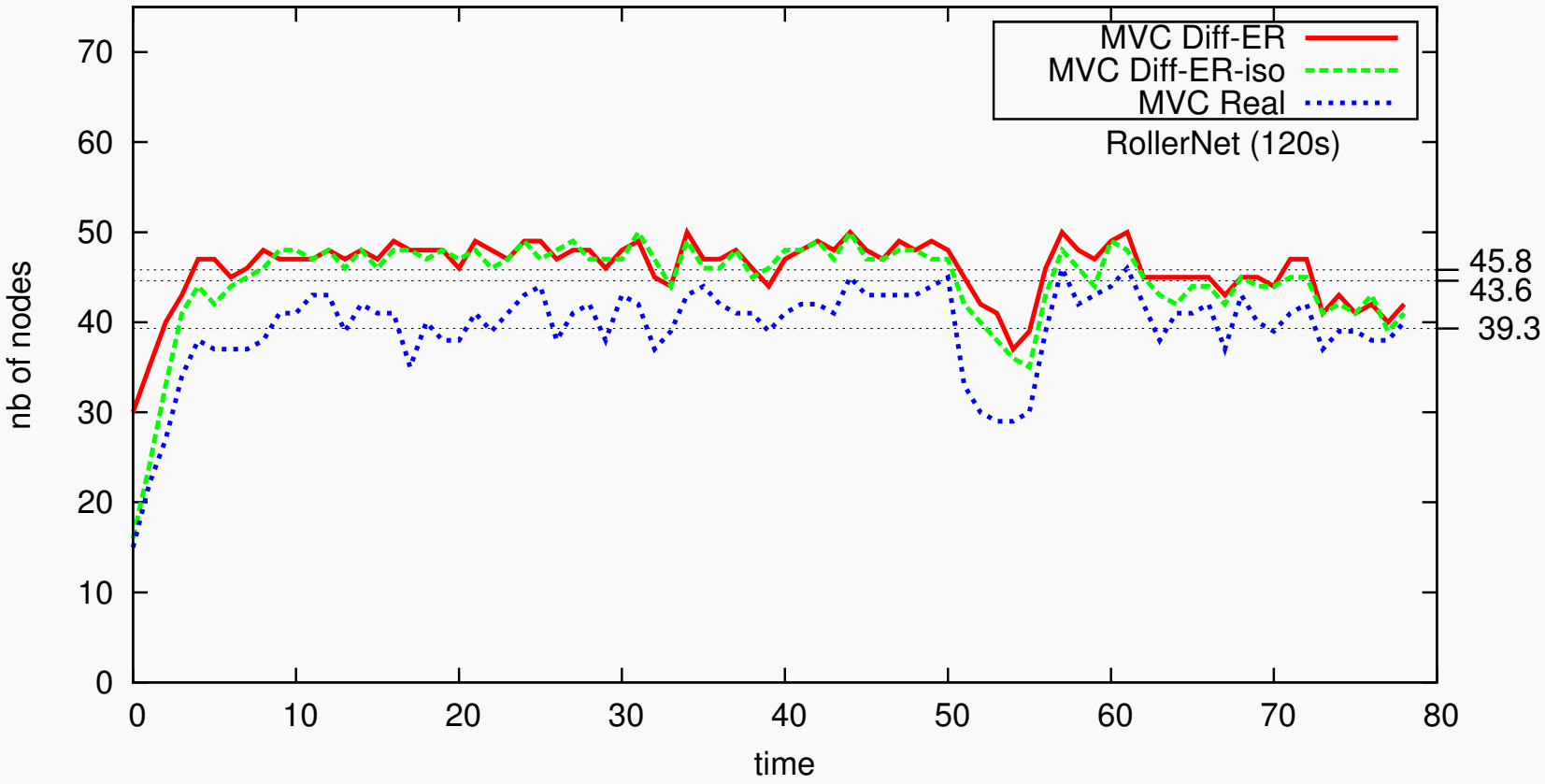
Datasets

Non-isolated nodes (several datasets)



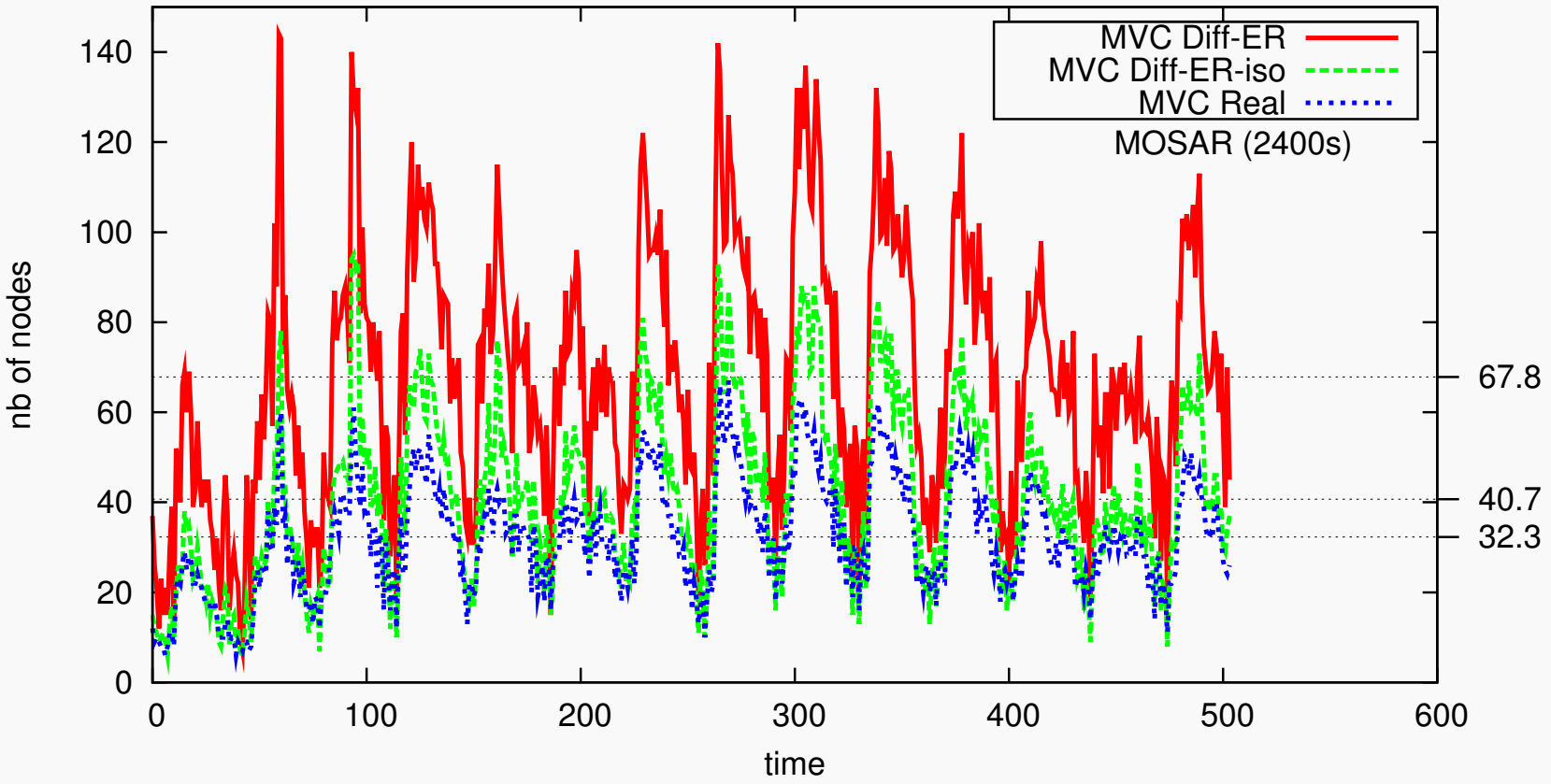
Three groups of experiments

Minimum Vertex Cover (RollerNet)



Same conclusion: MVC smaller than expected

Minimum Vertex Cover (MOSAR)



Same conclusion: MVC smaller than expected

Results

Parameters

Aggregation

Datasets

Conclusion

Conclusion

Results

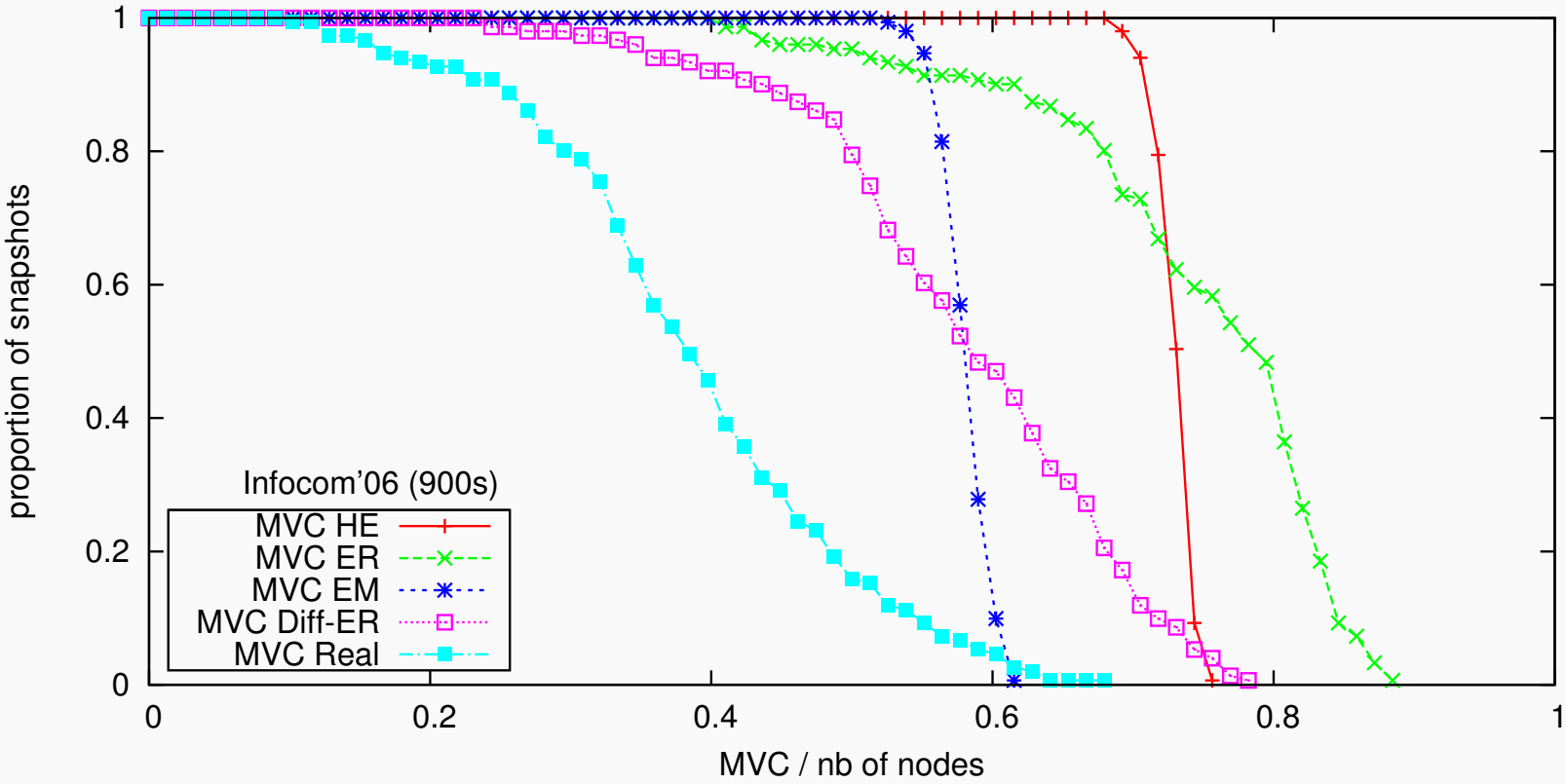
- few nodes involved in changes
- few nodes concentrate the changes

Generality

- limited influence of the aggregation
- "independent" of the contact network

$\Rightarrow$ special structure of changes

Models


proportion of snapshots
MVC / nb of nodes
Infocom'06 (900s)
MVC HE
MVC ER
MVC EM
MVC Diff-ER
MVC Real
0
0.2
0.4
0.6
0.8
1

Minimum Vertex Cover

Not concerned about complexity issues:

- NP-complete problem
- preprocessing called leaf removal very efficient on sparse graphs
- practical observation: it performs even better on our graphs