

# Vulnerability analysis methods for road networks

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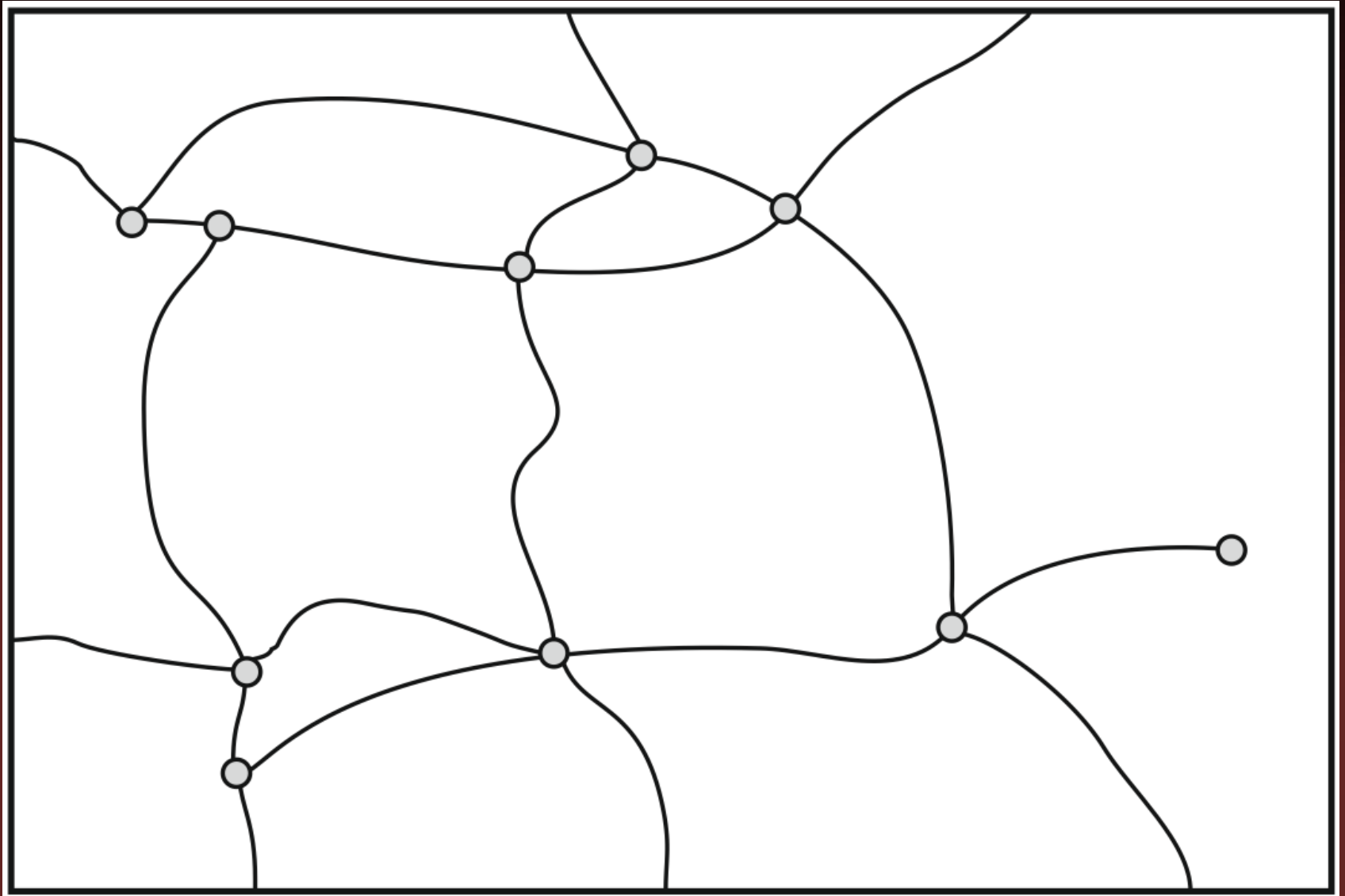
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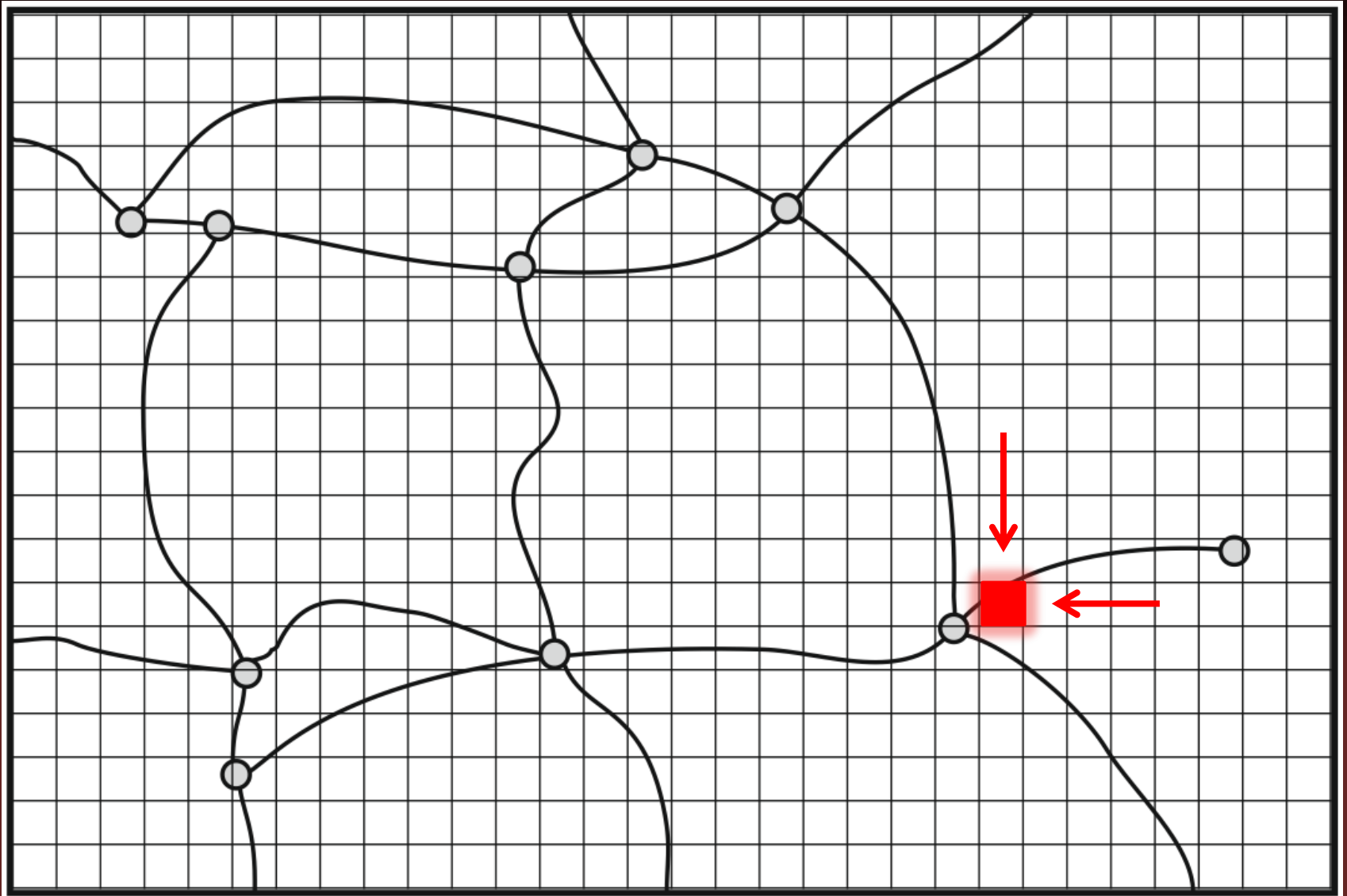
# Objectives

- Local × global vulnerability
- Network impacts of disasters
- Criteria – important links
- New algorithm → higher efficiency
- Case study

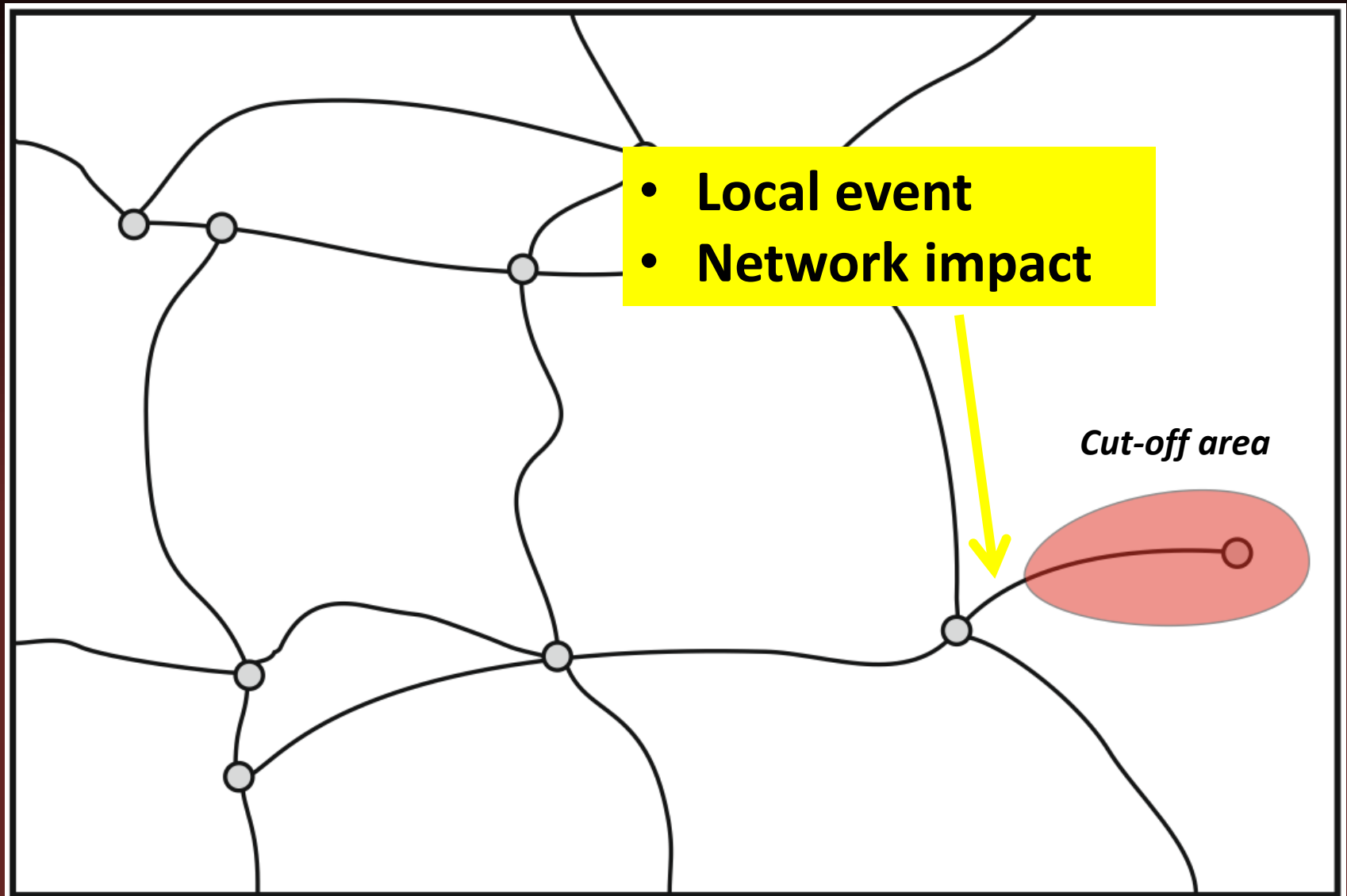
# Vulnerability



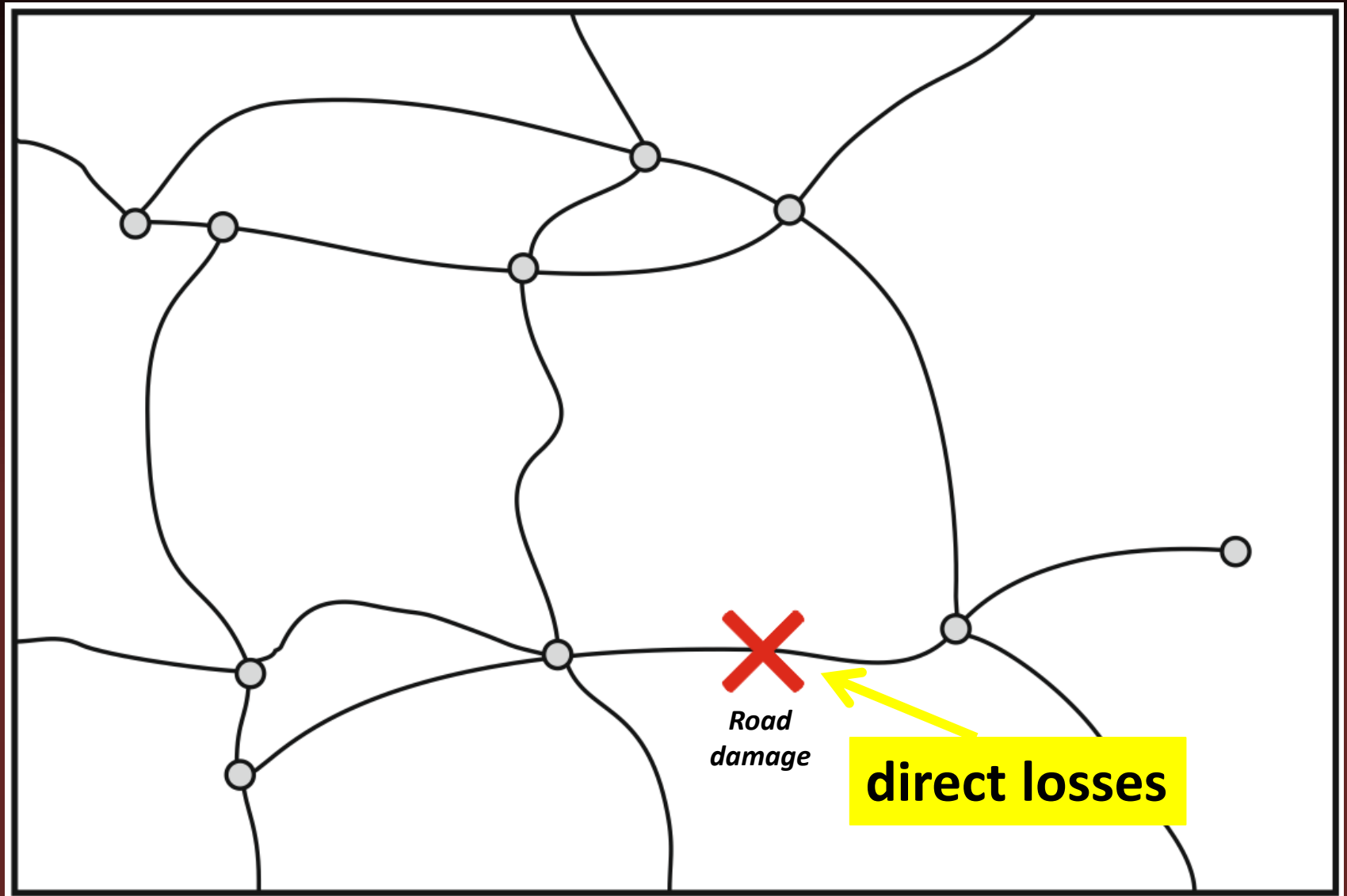
# Vulnerability – local grid approach



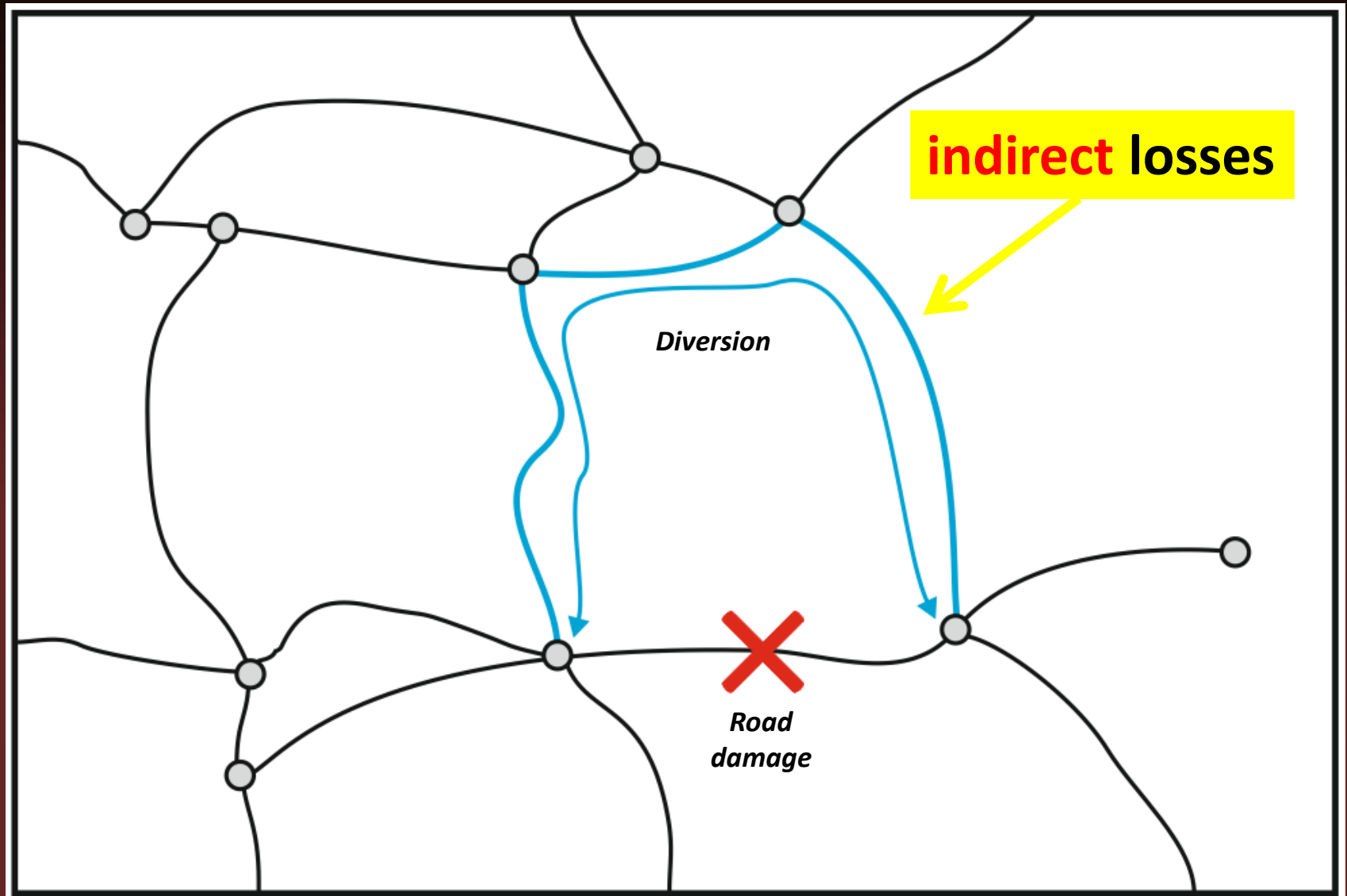
# Vulnerability of networks



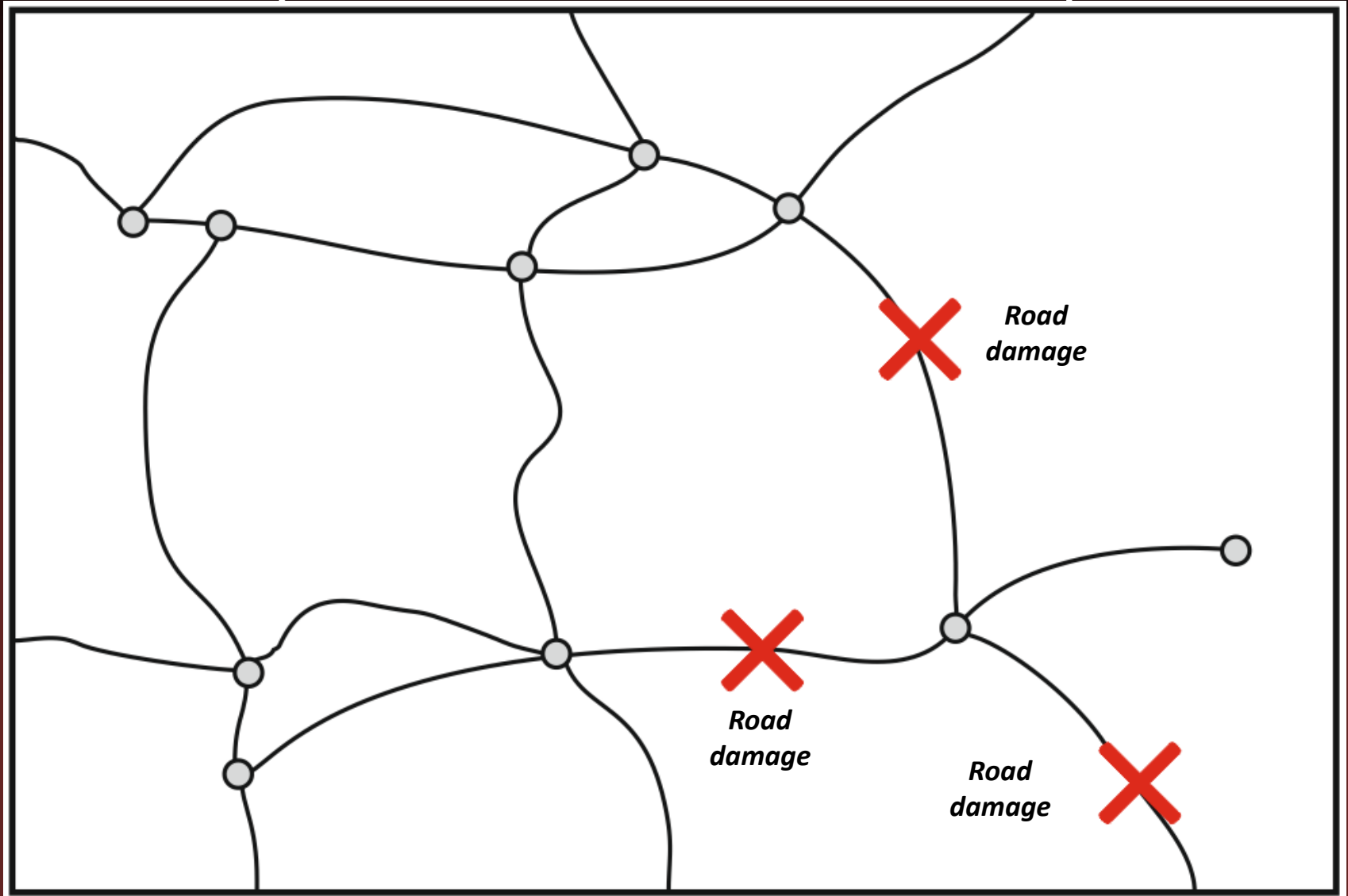
# Other impacts of road damage



# Link importance



# Natural disasters – usually **several** road link interruptions



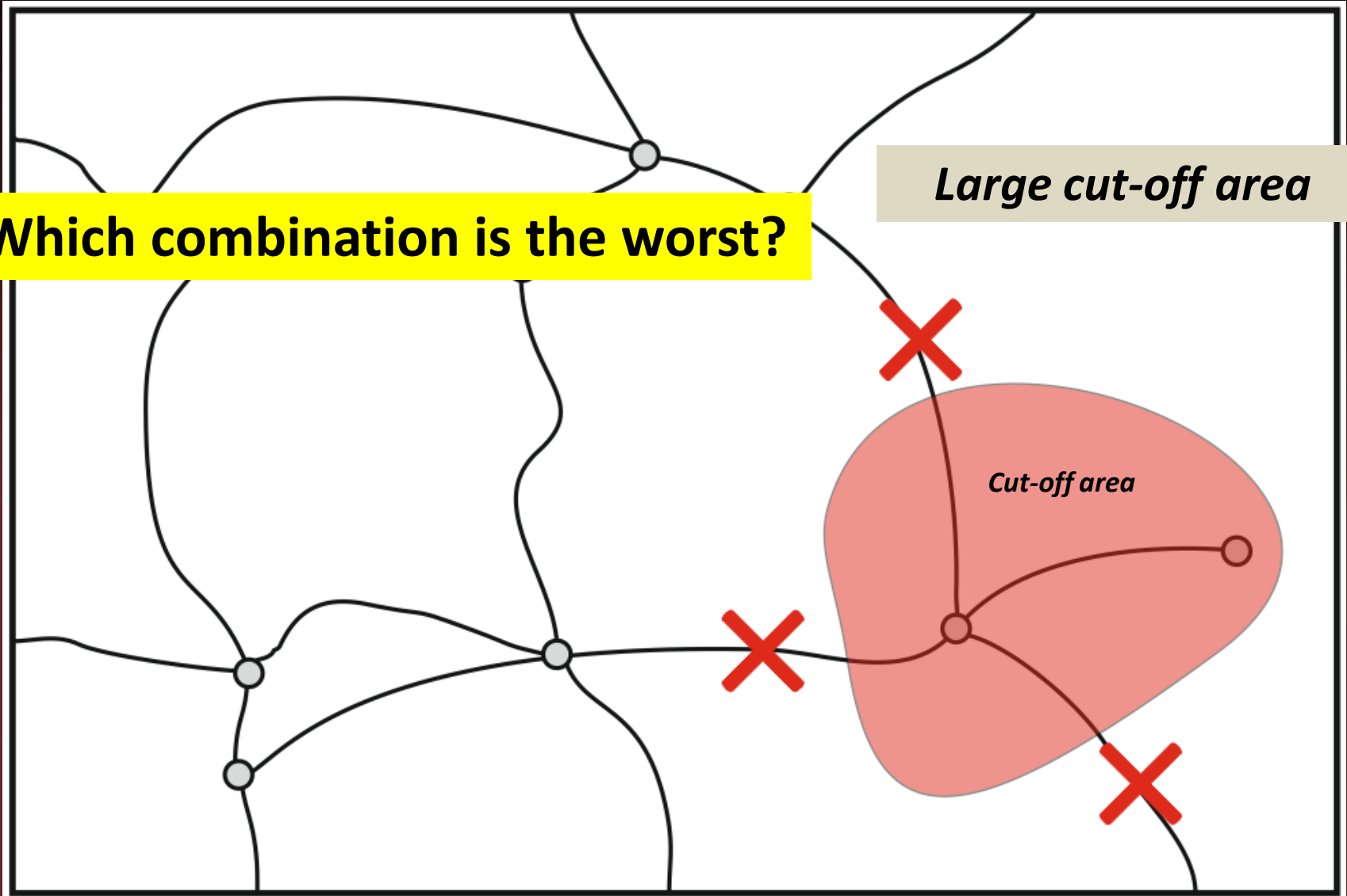


# ... and their consequences

**Which combination is the worst?**

*Large cut-off area*

*Cut-off area*



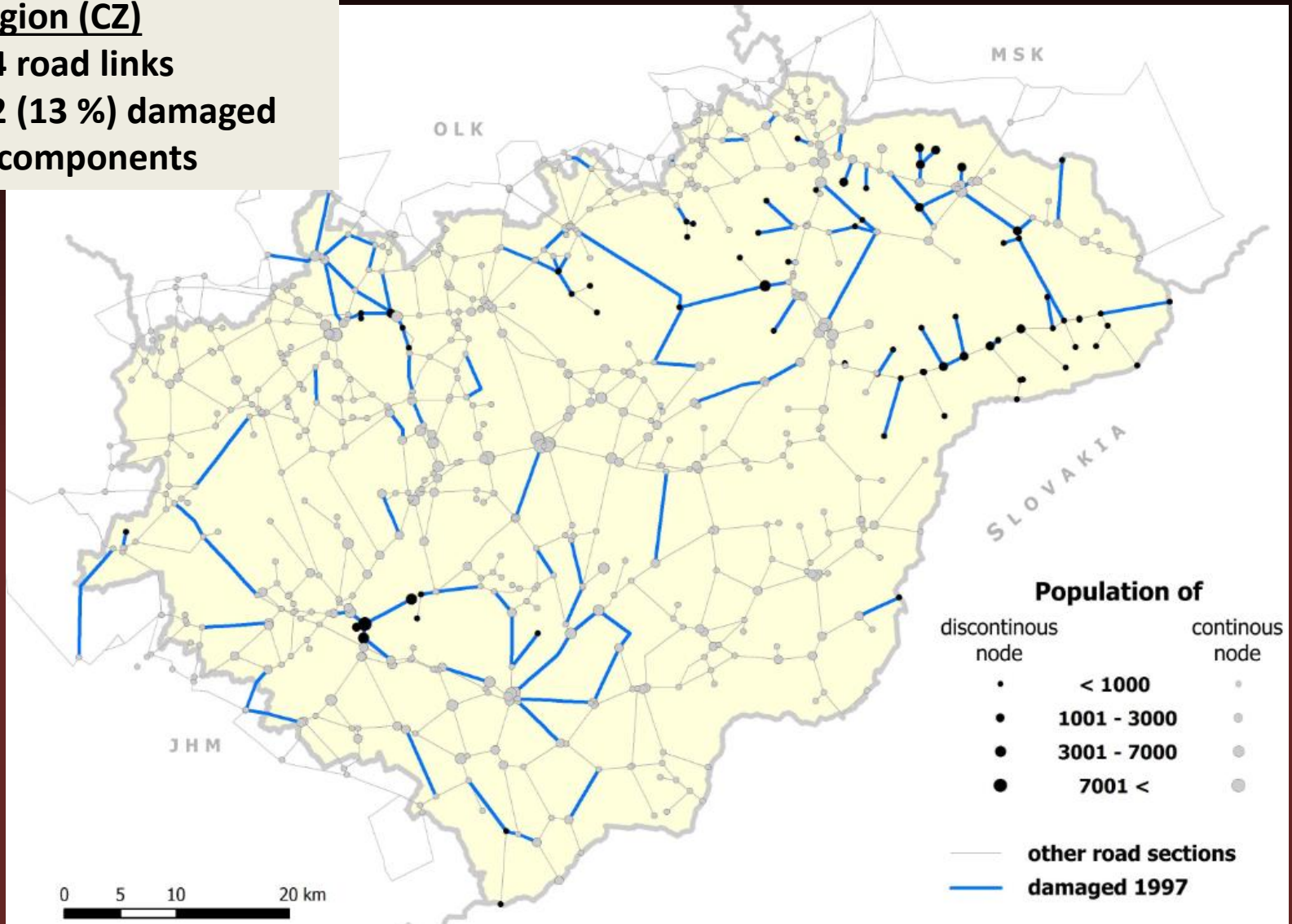
# Criteria of network vulnerability

- Topological
  - Number of components
  - Number of cut-off people
- Traffic flow
  - Overall increase in travel time (diversions)
  - Betweenness centrality index
  - ...

# Impacts of the July 1997 event

## Zlín region (CZ)

- 974 road links
- 122 (13 %) damaged
- 46 components



# Computational approaches

**Deterministic**

**Stochastic**



**Combinatory**

(Brutal force - all combinations)

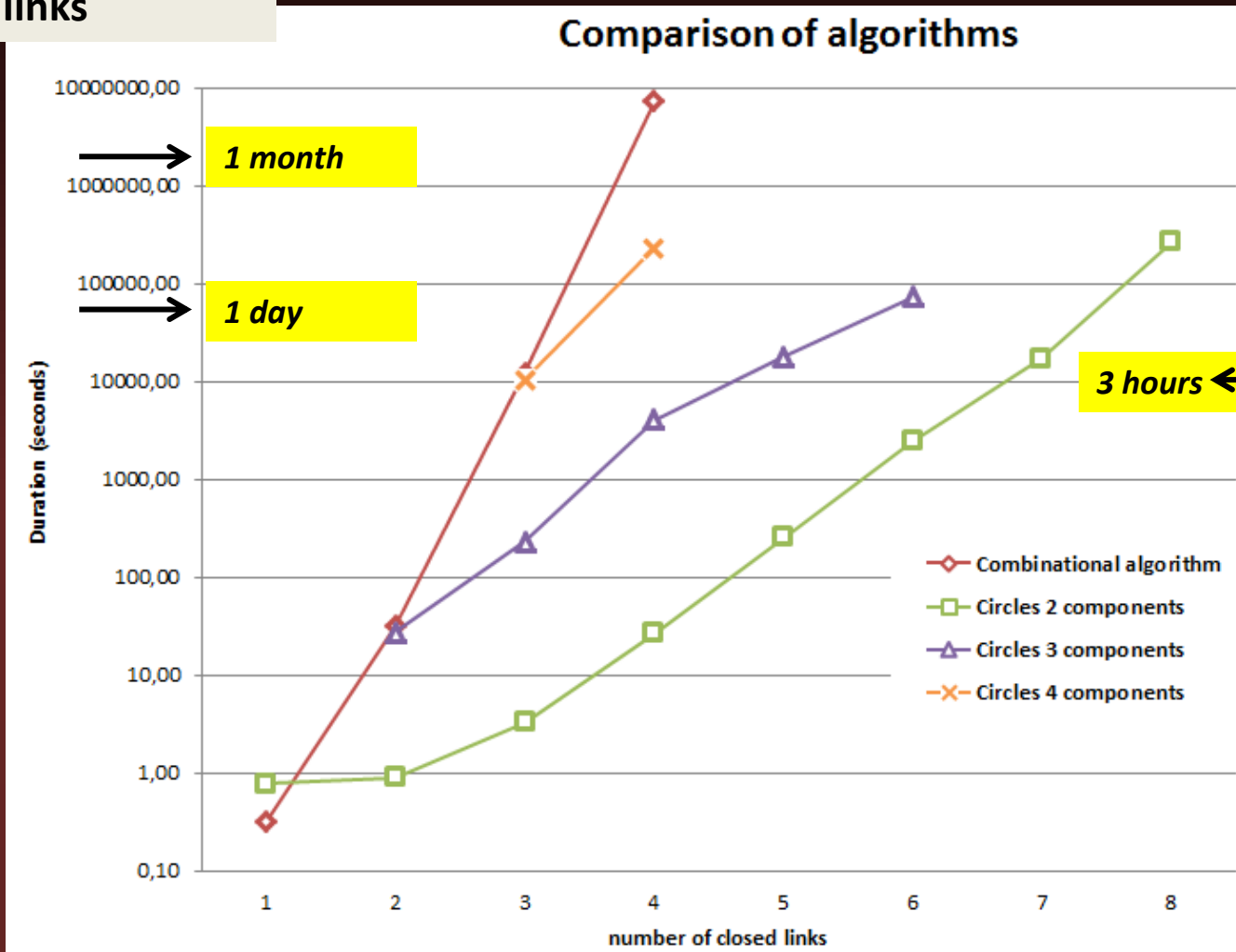
**Circles**

(Sidetrack algorithm)

# New algorithm based on “circles in graph”

Zlín region (CZ)

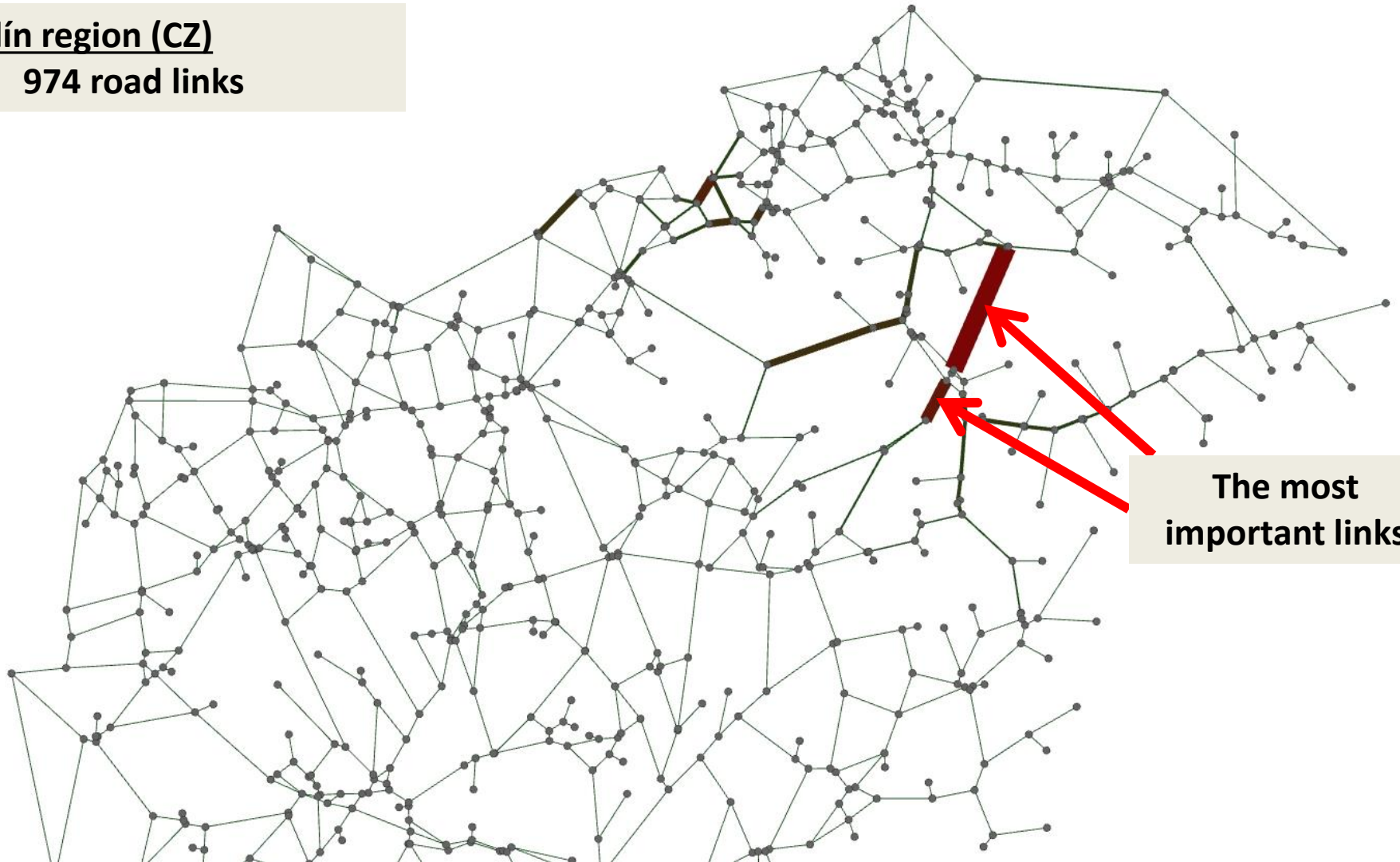
- 974 road links



# The weakest links

**Zlín region (CZ)**

- 974 road links



**The most important links**

# Summary

- Local × Network vulnerability
- Vulnerability criteria
- Large networks → high demand
- Efficient algorithm → better forecast
- Selection of **the most vulnerable** road links
- Possible applications:
  - Online cut-off risk assessment

Thank you  
for your attention

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