

Population distribution effects in backbone network cost

(Research plan)

Dimitris Maniadakis

Dept. of Informatics & Telecommunications

University of Athens

Outline

- **Background**
 - Main incentives
 - Network models
 - Population size distribution
- **Our approach**
 - Population distribution effects
 - Estimation of backbone network cost
- **Case study**
 - Belarus, Bulgaria, Belgium
- **Conclusions**

Main incentives

- Low adequacy of broadband provision in small cities
- Accurate estimates of investment costs take substantial time and resources
 - Operators (viability)
 - Regulators (subsidization)



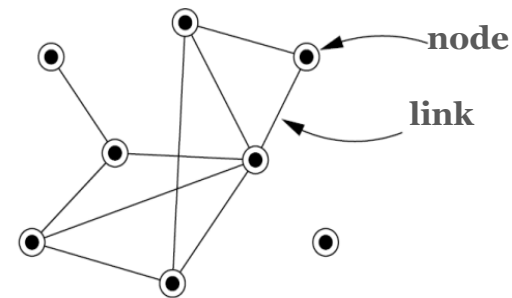
Mobistar's fixed network, Belgium

Network models

- Air transportation, electricity, Internet, social networks
- Topology?

Erdos-Renyi, 1960
 Watts-Strogatz, 1998
 Barabasi-Albert, 1999
 Kumar et al, 2000
 Pennock et al, 2002
 ...

Waxman, 1988
 Fabrikant et al, 2002
 Barthelemy et al, 2003
 Jung et al, 2008
 Qian et al, 2009
 ...



Gravity model

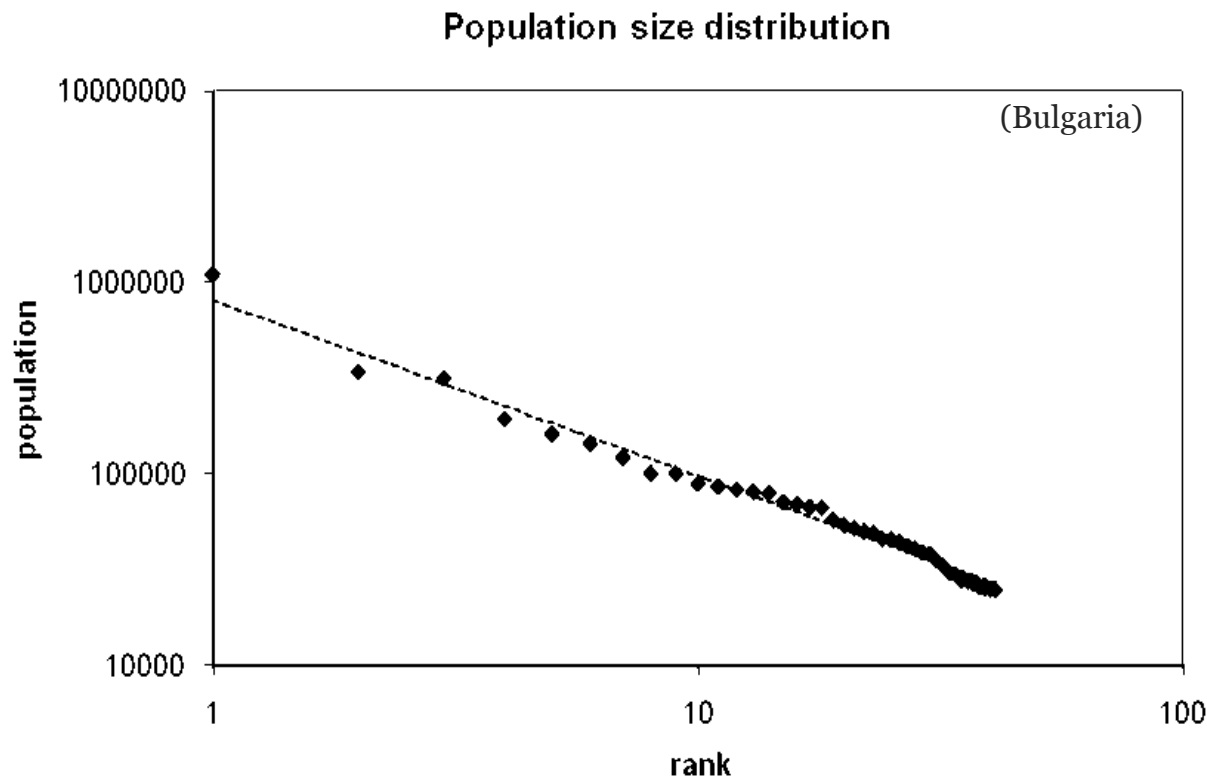
$$T_{ij} \sim \frac{P_i P_j}{d_{ij}^2}$$

- They ignore geography!
- Focus on node degree

- Spatial network models
- Focus on traffic estimation

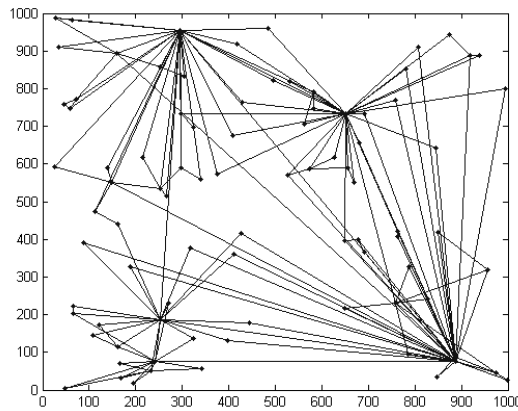
Population size distribution

- Pareto distribution (power law)
- “ α ” is characteristic of each country, $\alpha \in [0,7, 1,7]$

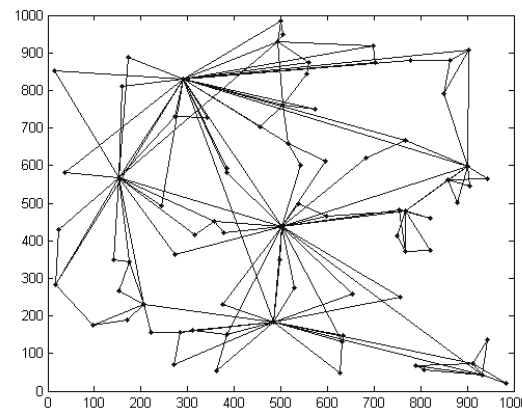


Our approach

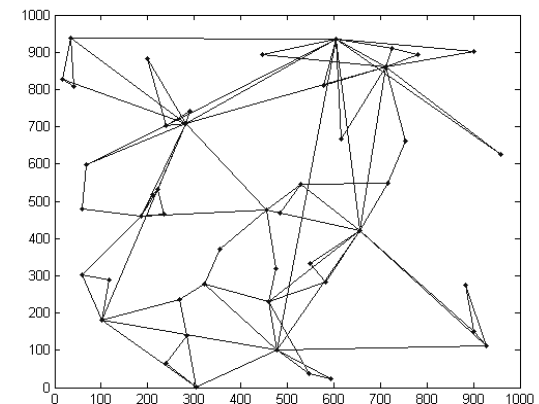
- Combination of Pareto distribution with gravity model
- Nodes represent cities, links represent physical routes
- Network length assumed as basic factor in cost estimation
- Simulations in each country's surface size



$\alpha=0,7$



$\alpha=1,1$

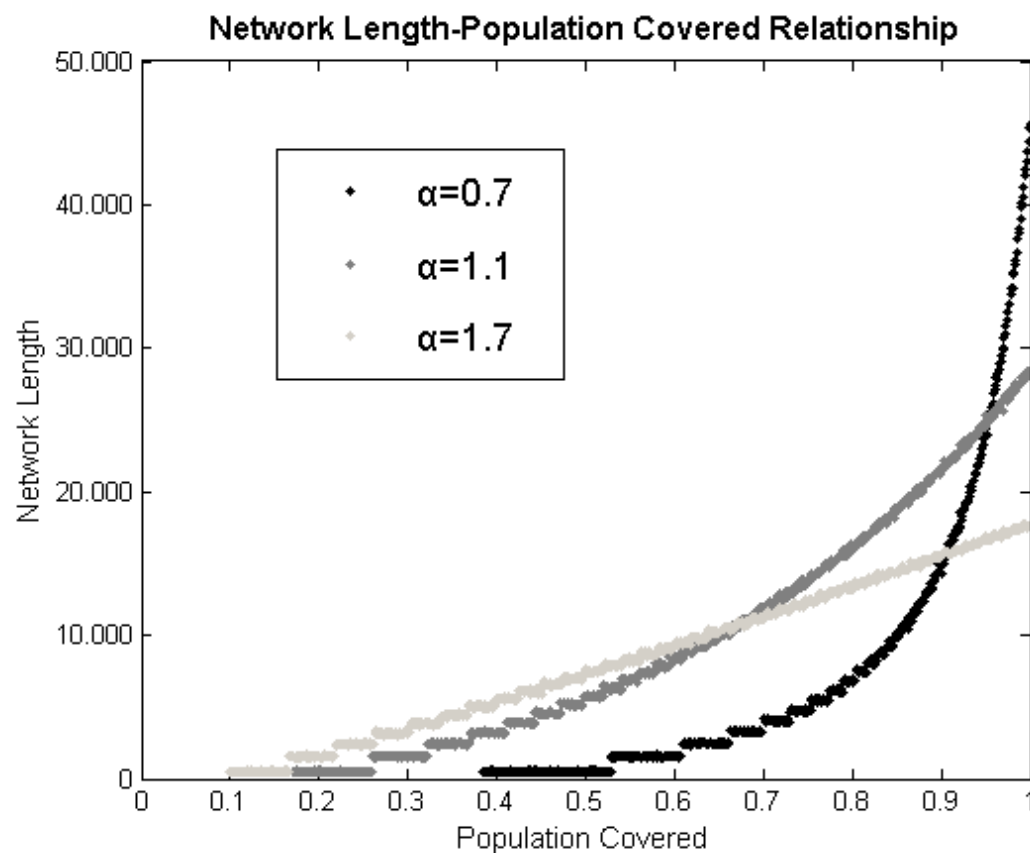


$\alpha=1,7$

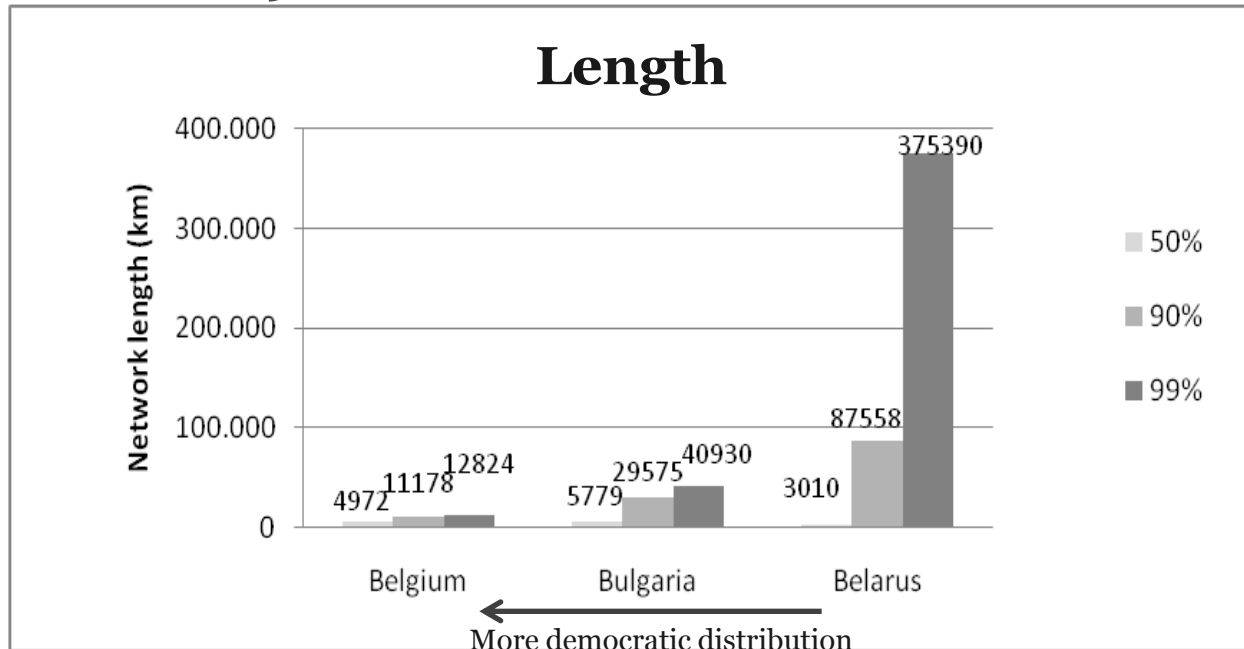

 More “democratic” distribution

Population distribution effects

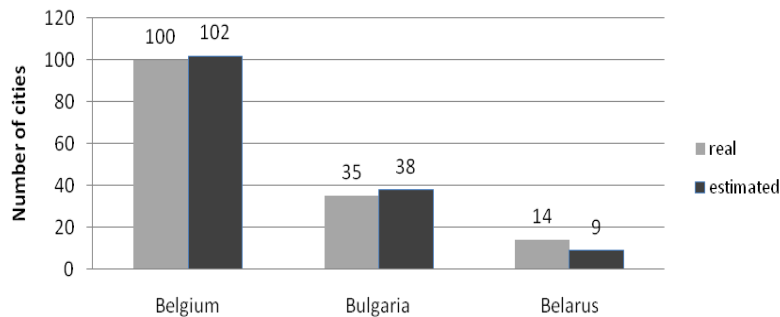
- Estimation of backbone network cost (length)



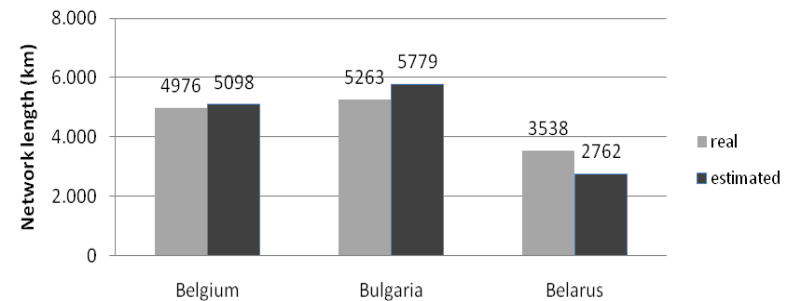
Case study



Cities
50% population coverage



Length
50% population coverage



Conclusions

- Variation of gravity model
- Rapid method for estimating backbone cost
- Population size distribution plays significant role in cost behavior
- Implications for operators and regulators

- Our future goals
 - Develop more realistic network models
 - Relate population distribution with operating cost
 - Deal with capacity planning

Selected References

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Questions - Discussion

Thank you!

Dimitris Maniadakis
D.Maniadakis@di.uoa.gr