A Market-based Pricing Scheme for Grid Networks

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Introduction
Pricing Scheme
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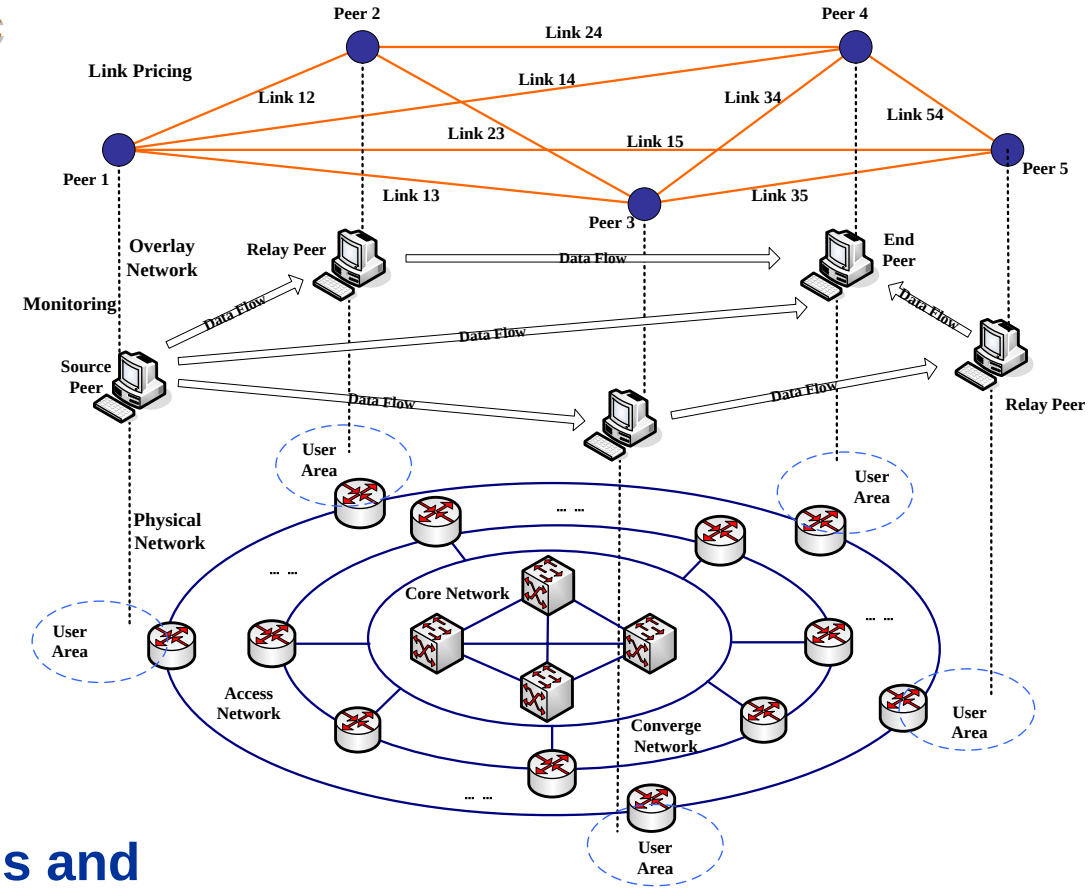
Conclusion

Introduction

- **Grid network traffic is treated according to traditional traffic management methods**
  - **High link load variation**
  - **Low average link load**

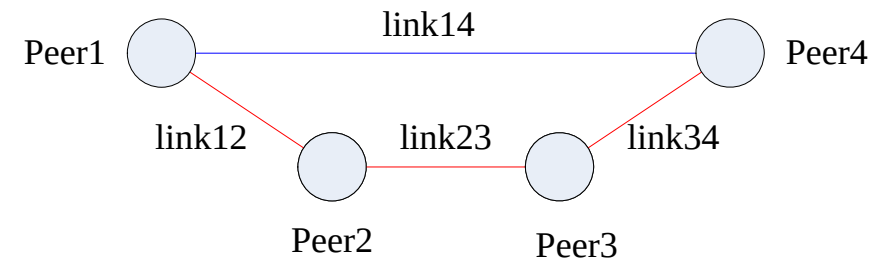
- **Approach: Economic Grid traffic management**
  - **Market-based pricing scheme**
  - **Optimally balance link load to avoid congestion**
  - **Improve network‘s robustness and stability**
  - **Increase effective network capacity**



Pricing Scheme (1)

- **Approach**
  - Pricing component in every network domain
  - Determines link prices based on current link load reported by peers in a periodic manner

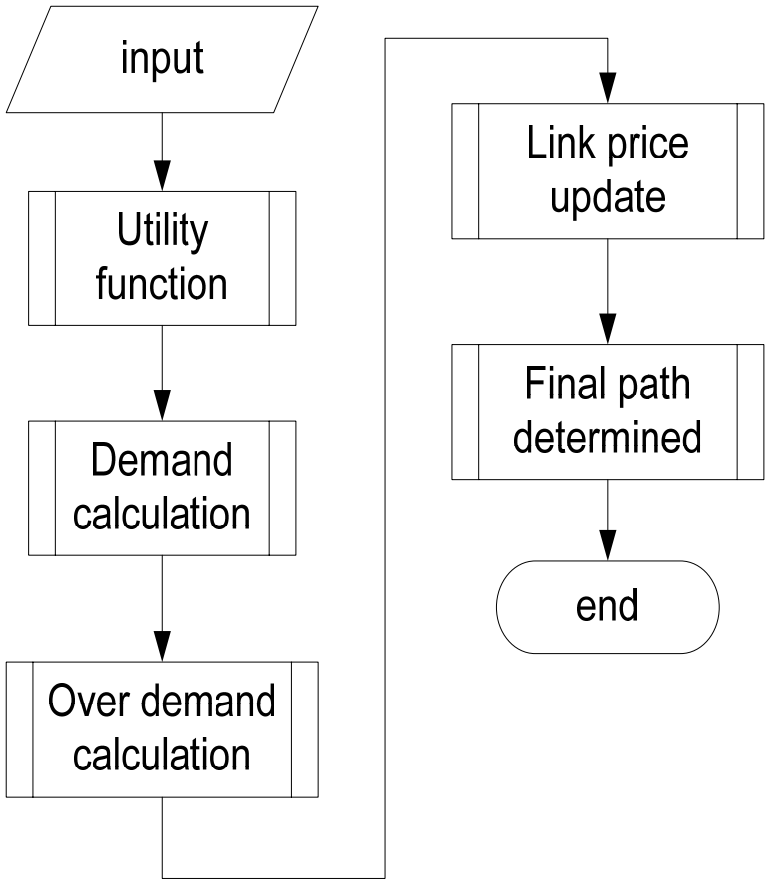
- **Model**
  - Peers form an overlay network
  - Each link can be used to transfer data for several peers
  - A path is composed of one or more links



Path 1 = {link14}
Path 2 ={link 12, link 23, link 34}

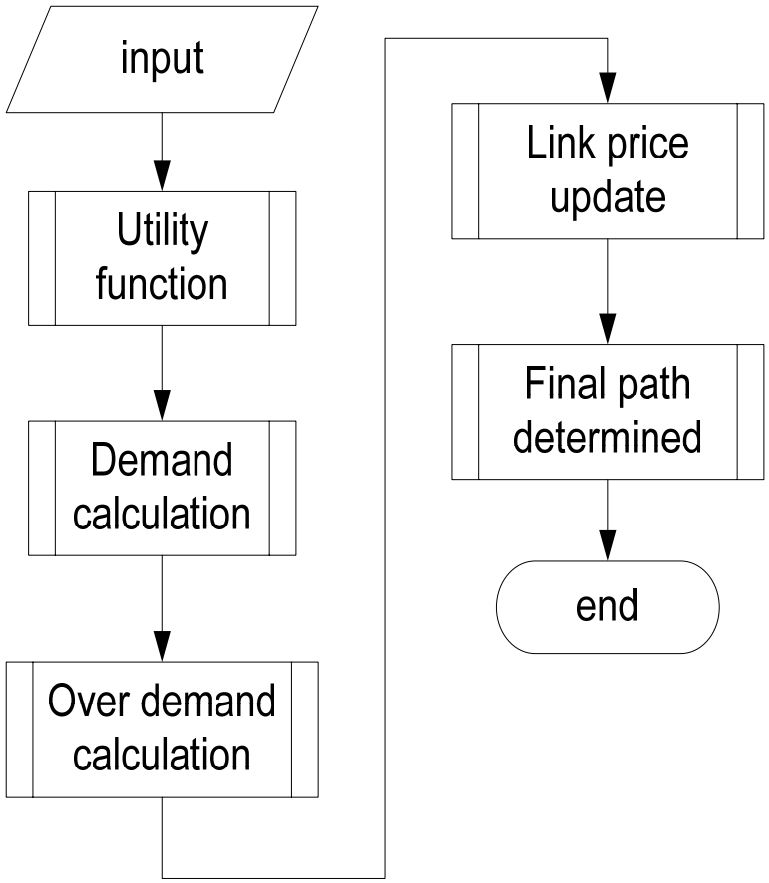
Pricing Scheme (2)

- **Pricing Algorithm**
  - The path solution space is determined by any routing algorithm
  - A utility function describes the satisfaction of a peer for a given path
  - Constraint: The total price for a path must not exceed a peer's budget
  - The set of potential paths can be 0, 1, or more depending on a peer's budget
  - At most one path is selected



Pricing Scheme (3)

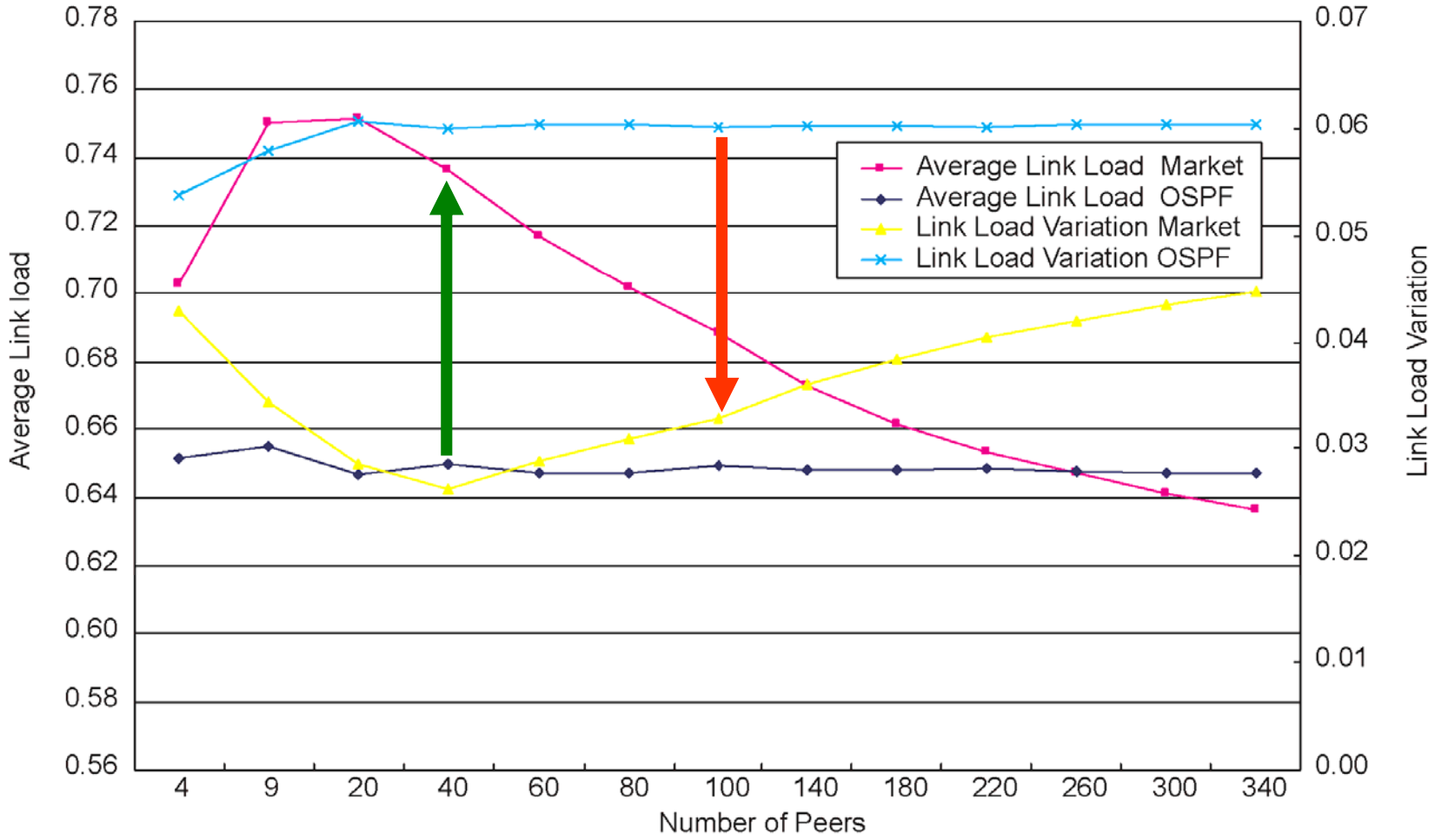
- **Pricing Algorithm (cont'd)**
  - The total demand of a link is the sum of demands of peers interested in that link
  - Over-demand is the difference between total demand and supply of a link
  - If over-demand is positive, link price increases, otherwise it decreases
  - These steps are repeated several times. Finally, the iteration round with the highest total utility is chosen



Simulation and Evaluation (1)

- **Assumptions**
  - Monte Carlo simulations with 100000 simulation runs
  - The network scale ranges up to 340 peers
  - The network topology is a fully meshed one
  - A path has at most two hops (links)
  - Link background loads and traffic requests generated randomly

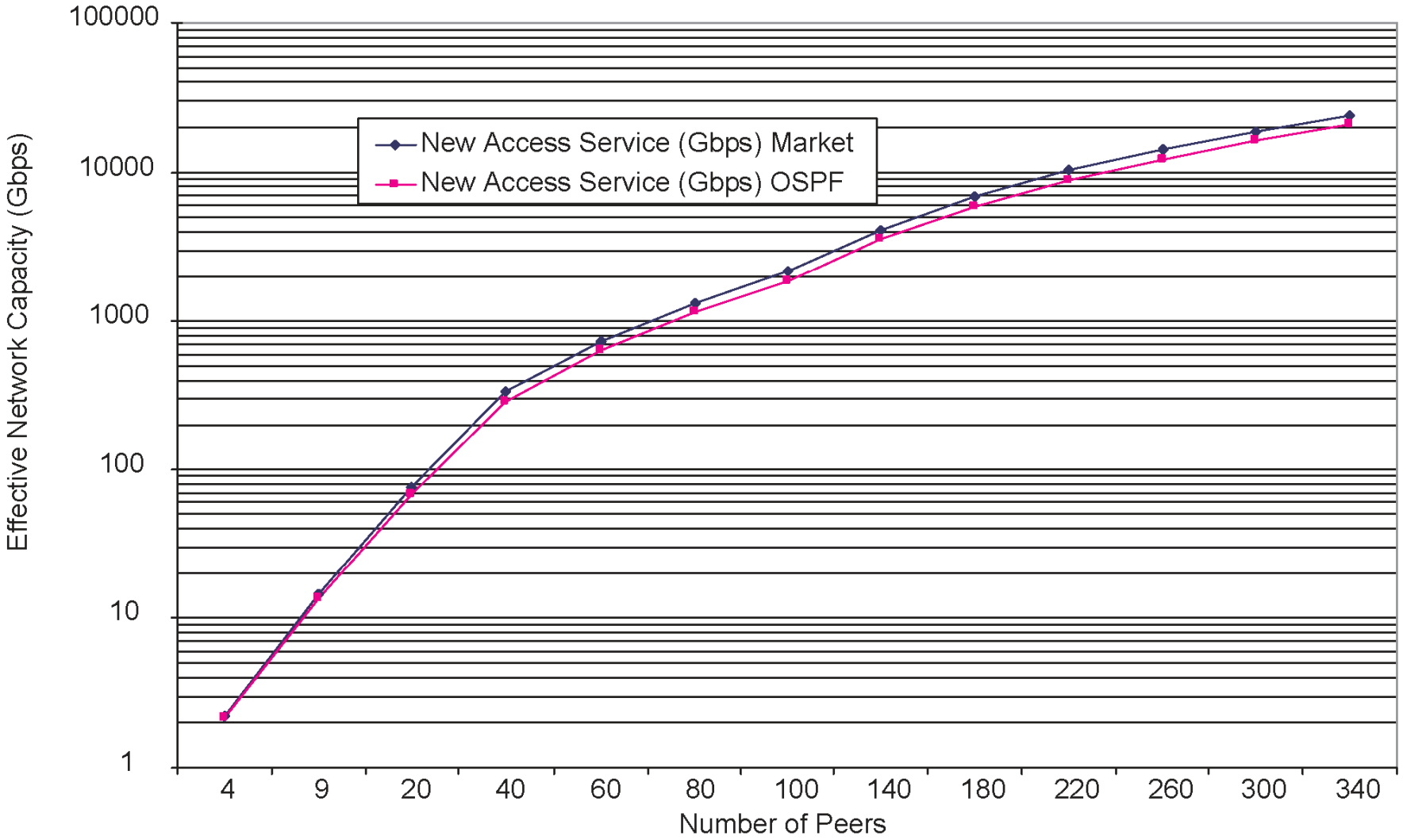
Simulation and Evaluation (2)



Pricing scheme results in smaller link load variation than OSPF

Average link load with pricing scheme is higher than with OSPF up to 200 peers

Simulation and Evaluation (3)



10% more traffic can be carried compared to OSPF

Simulation and Evaluation (4)

- **Computational complexity**

# Peers	10	50	100	150	200	250	300
Time (sec.)	**0.00375**	**0.0228**	**0.17**	**0.5706**	**1.4044**	**2.7874**	**4.8874**

- **Computational complexity of the pricing scheme increases with the increasing number of peers within a network.**
- **Those worst-case results when all peers get a service request from all other peers at the same time, which is quite unusual in a real network. Hence, in reality the computational complexity will be much lower than the numbers shown above.**

Conclusions

- **Market-based pricing scheme for Grid networks**
  - Reduces link load variation compared to OSPF
  - Thus, improves the network's robustness and stability
  - Increases the network resource utilization as it allows to accommodate more services compared to the OSPF method
  - Ten percent more services can be accommodated in the network
  - More efficient usage of network resources

- **Future work**
  - Consider more hops between peers
  - Improve scalability of the scheme by dividing network into multiple domains

Acknowledgements

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