Improving Unstructured Peer-to-Peer Systems by Adaptive Connection Establishment

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Outline

- 1. Introduction
- 2. Related Work
- 3. ACE Three Main Phases
- 4. Adjustable Arguments
- 5. Simulation & Performance Evaluation
- 6. Conclusion

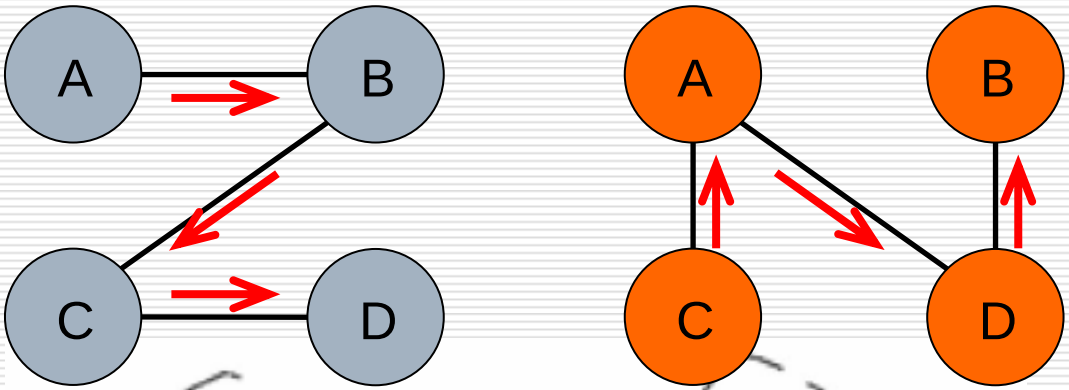
1. Introduction

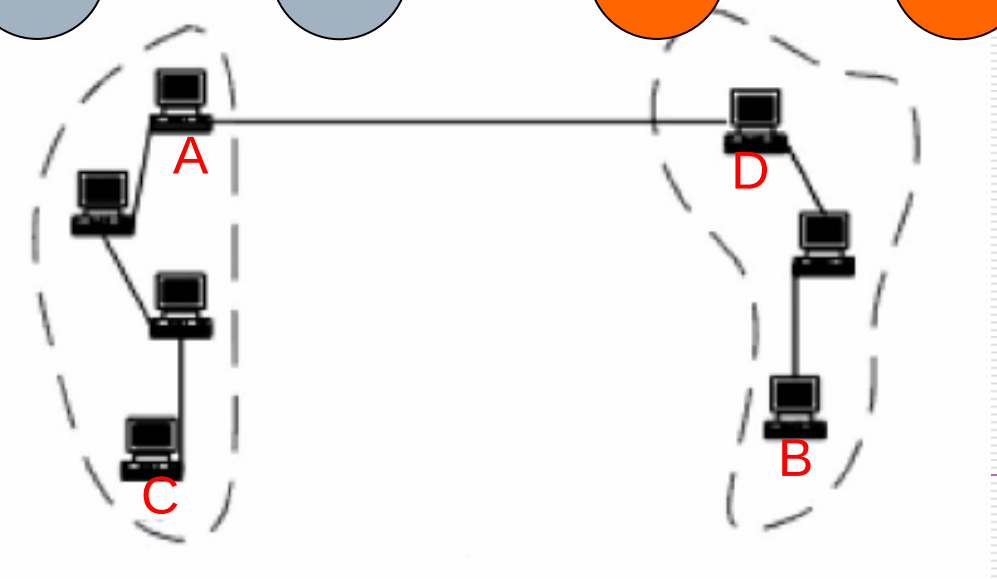
- *05/26/05 Lab Meeting*

  LTM (Location-aware Topology Matching)
- **Problem Definition**
  - In unstructured P2P system, random join / leave
  - Physical/Logical (Overlay) mismatching problem
- **Goal**
  - Build an efficient overlay
  - Reduce unnecessary traffic
  - Not shrink the search scope
  - Fully distributed

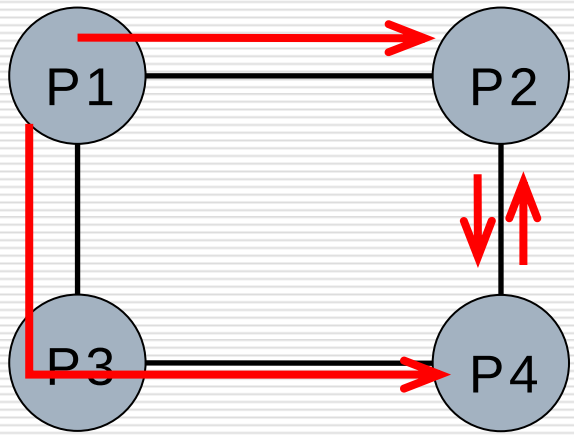
Problem & Goal

Physical / Logical mismatch





Overlay problem



2.Related Work

- Other ways to reduce traffic cost in unstructure-P2P system
  - Forwarding-based
    - Only forward to subset of neighbors
  - Index cache-based
    - Remember index of files/peers used before
  - Overlay topology optimization
    - LTM

3. ACE Three Main Phases

- Phase 1:

  Neighbor Cost Table Construction and Exchanging

- Phase 2:

  Selective Flooding (SF) : *using minimum spanning tree algorithm*

  - Flooding neighbor Non-flooding neighbor

- Phase 3:

  Overlay Optimization

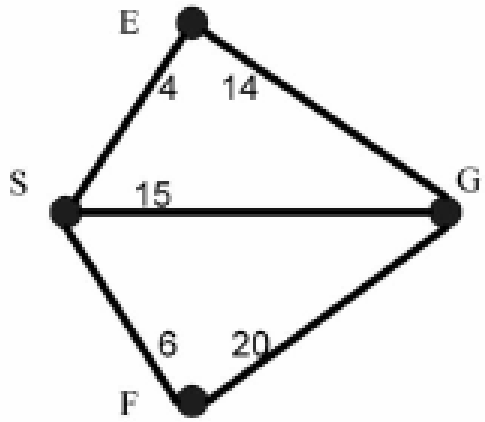
Phase 1
Phase 2

S		
	E	4
	F	6
	G	15

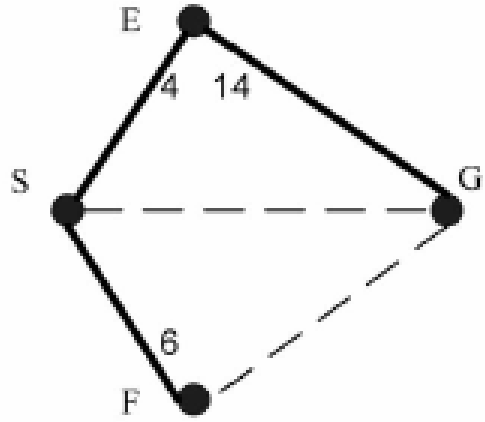
E		
	S	4
	G	14

F		
	S	6
	G	20

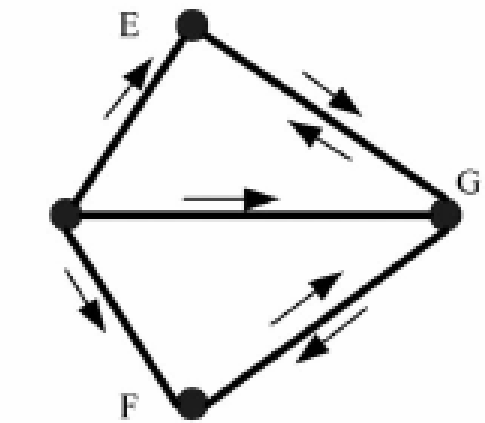
G		
	E	14
	F	20
	S	15



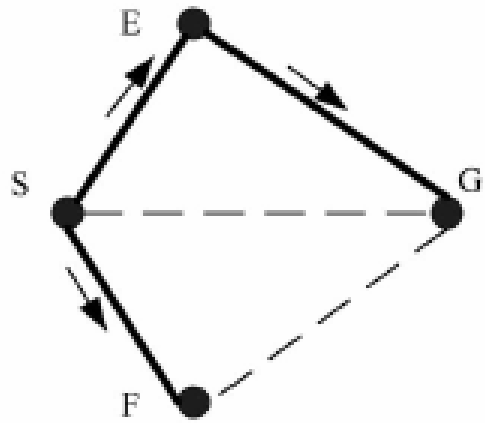
(a)



(b)

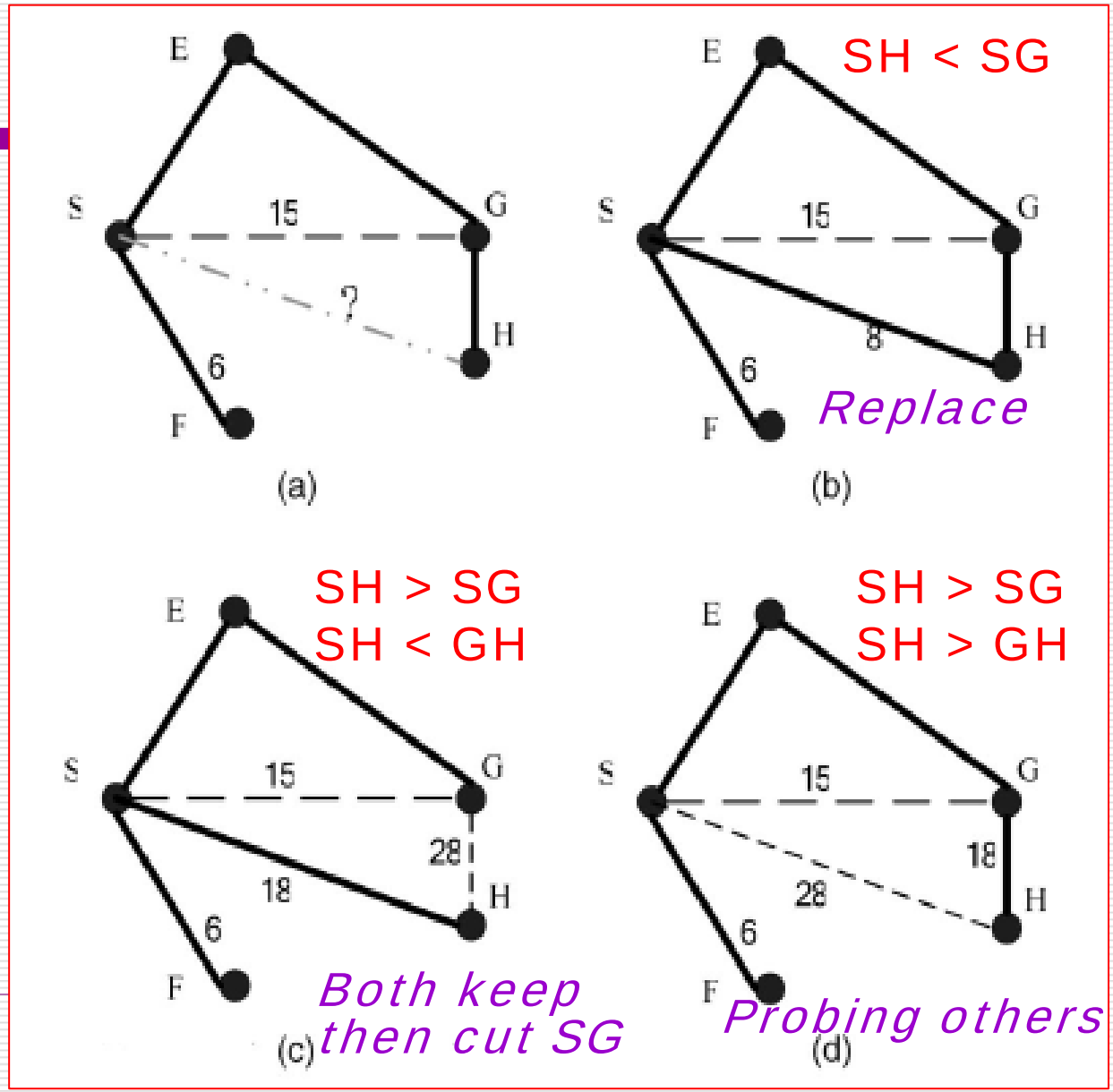


4+14+14+15+
6+20+20=93



6+4+14=24

Phase 3

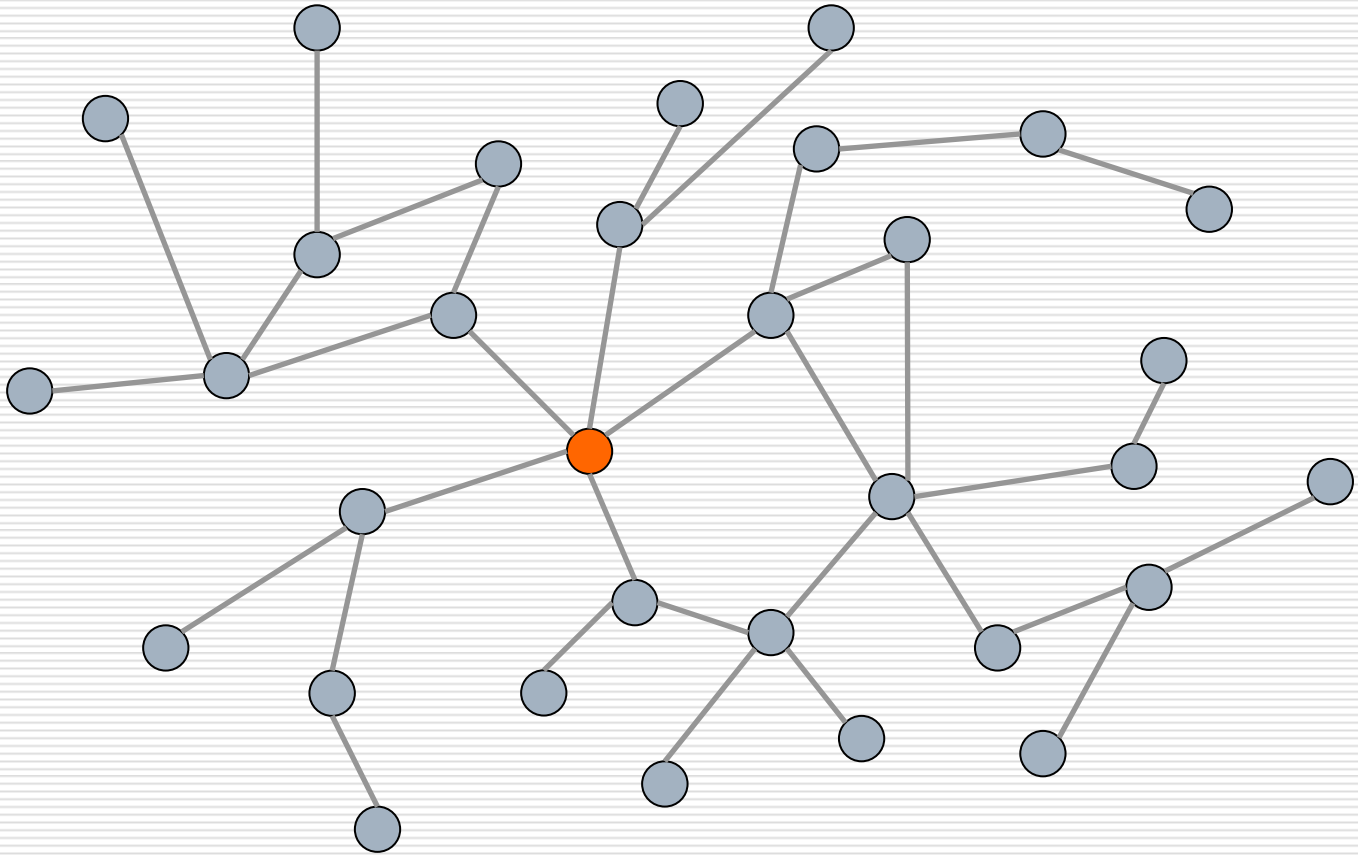

E
S
15
G
?
H
6
F
(a)
E
SH < SG
S
15
G
8
H
6
F
Replace
(b)
E
SH > SG
SH < GH
S
15
G
28
18
H
6
F
Both keep
then cut SG
(c)
E
SH > SG
SH > GH
S
15
G
18
28
H
6
F
Probing others
(d)

4. Adjustable arguments

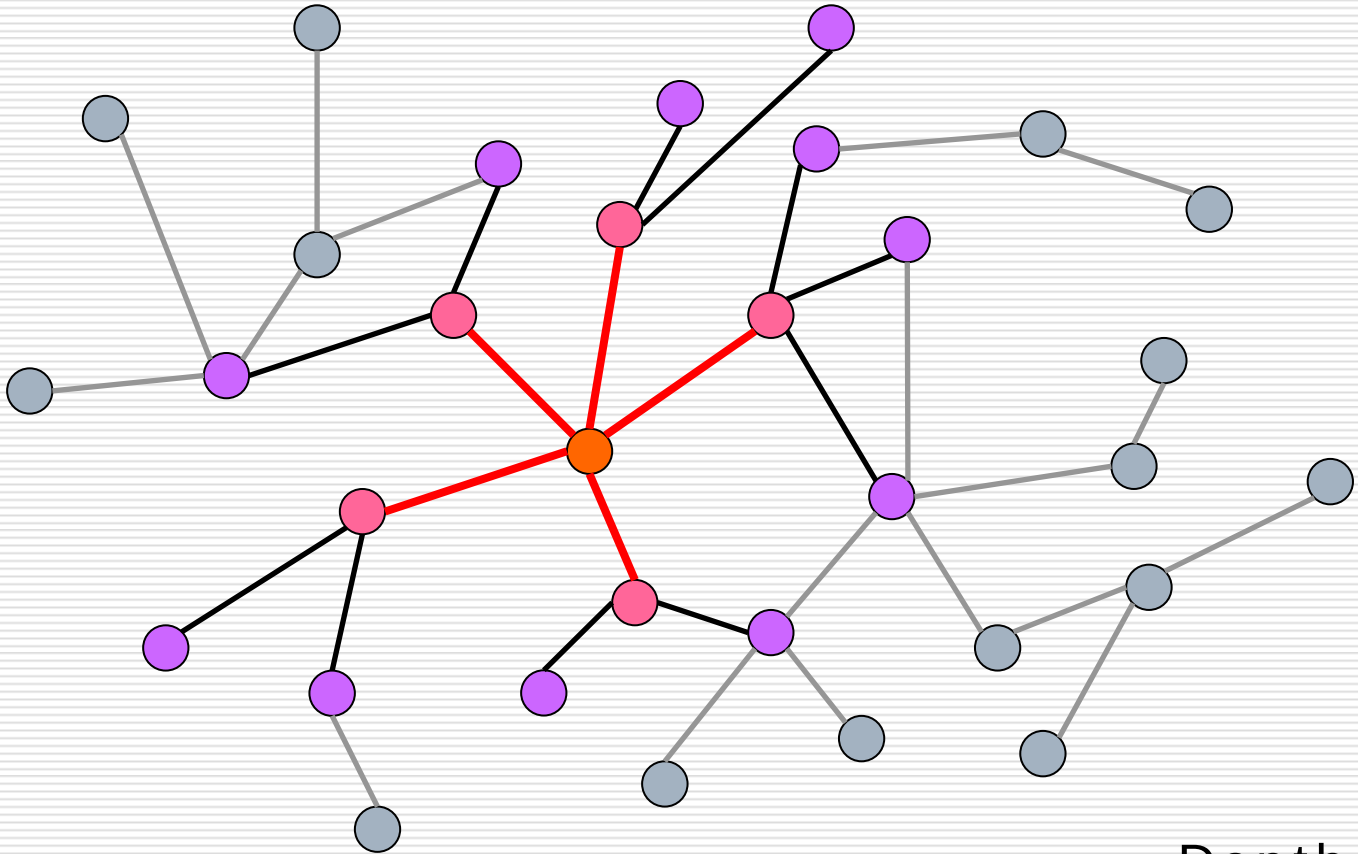
- Depth of Optimization

- The period of exchanging Neighbor Cost Table time
  - Event driven
  - period

Depth of Optimization

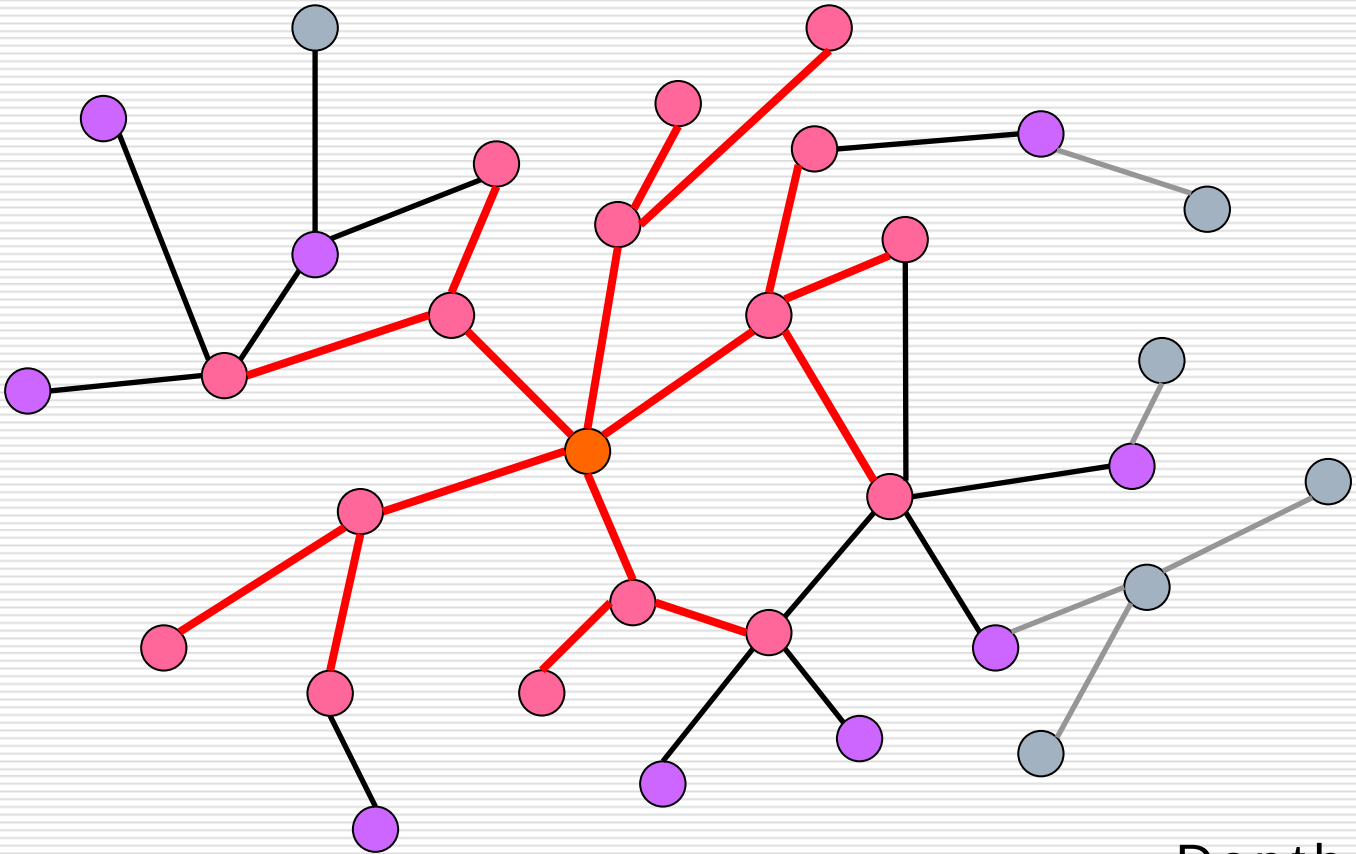


Depth of Optimization



Depth = 1

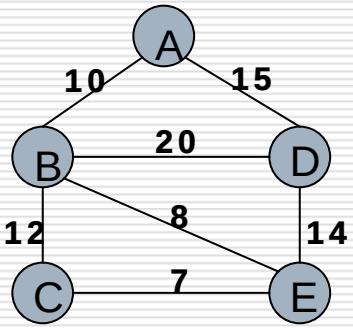
Depth of Optimization



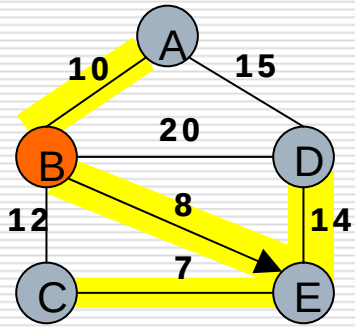
Depth = 2

1-neighbor closure

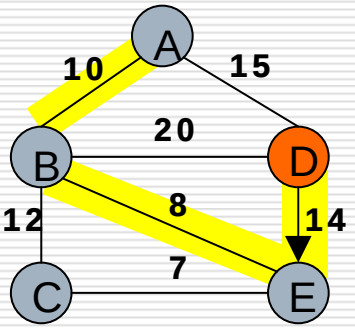
Query Path		Corresponding Cost
From	To	
A	B, D	10+15=25
B	E	8
D	E	14
E	C, D	7+14=21
Total Cost		68



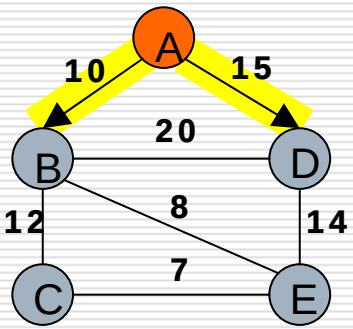
(a)



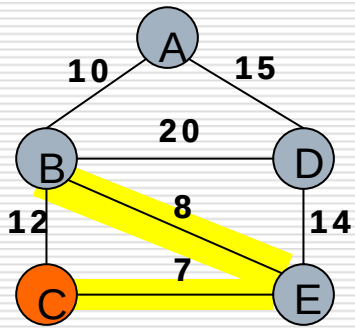
(c)



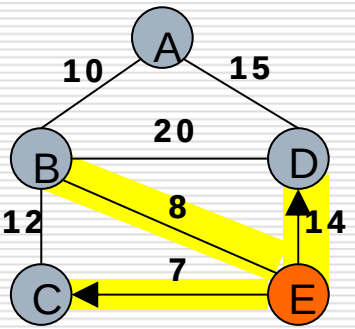
(e)



(b)

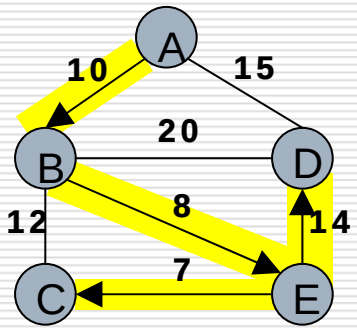


(d)



(f)

2-neighbor closure



Query Path		Corresponding Cost
From	To	
A	B,	10
B	E	8
E	C, D	7+14=21
Total Cost		39

5.Simulation & Performance Evaluation

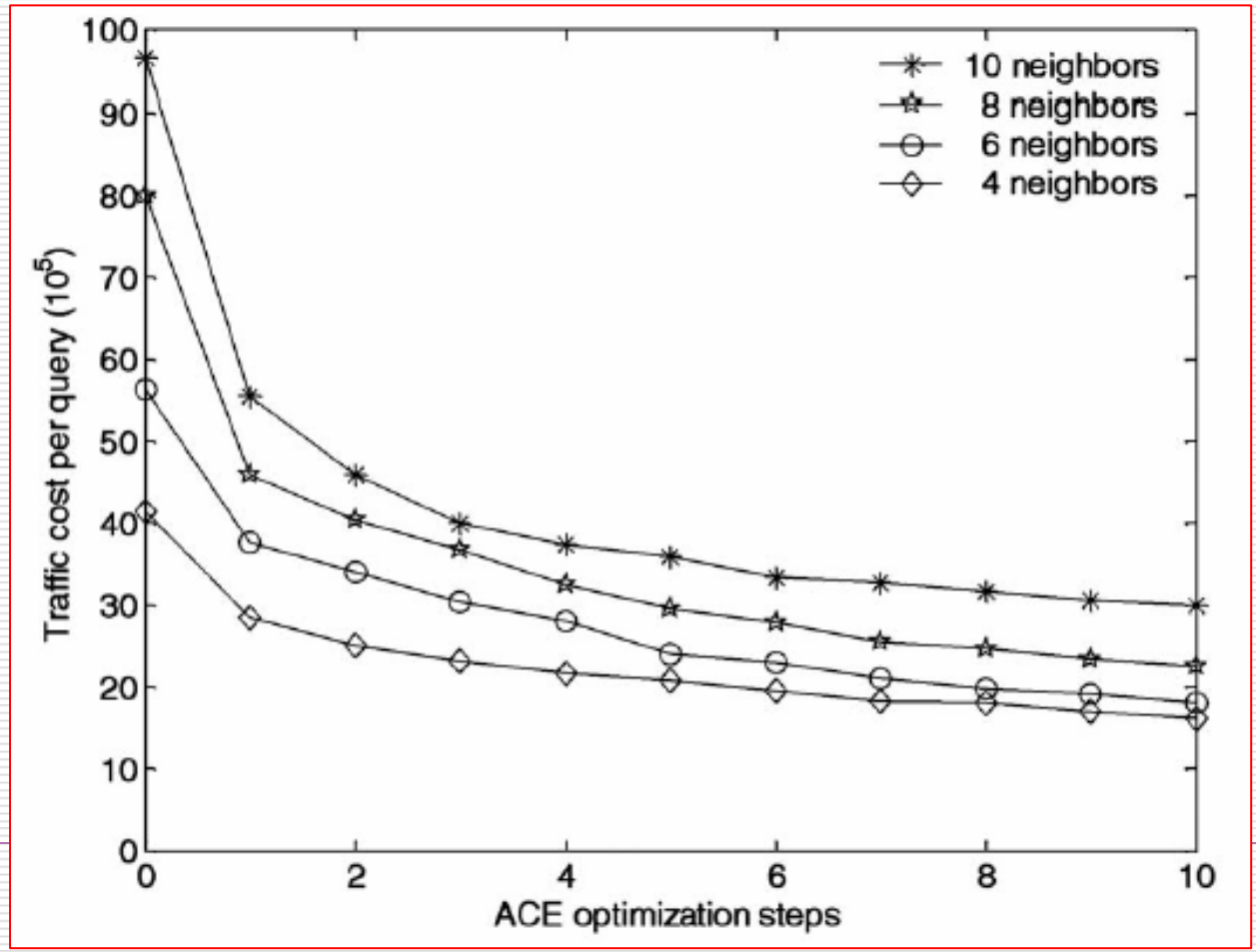
- Performance Metrics
  - Traffic cost
  - Query response time
  - Search scope
  - Optimization rate
    - Query traffic reduction / overhead traffic increment
  - Frequency ratio R (Stability of structure)
    - Frequency of using overlay / frequency of cost information changes

Simulation Environment

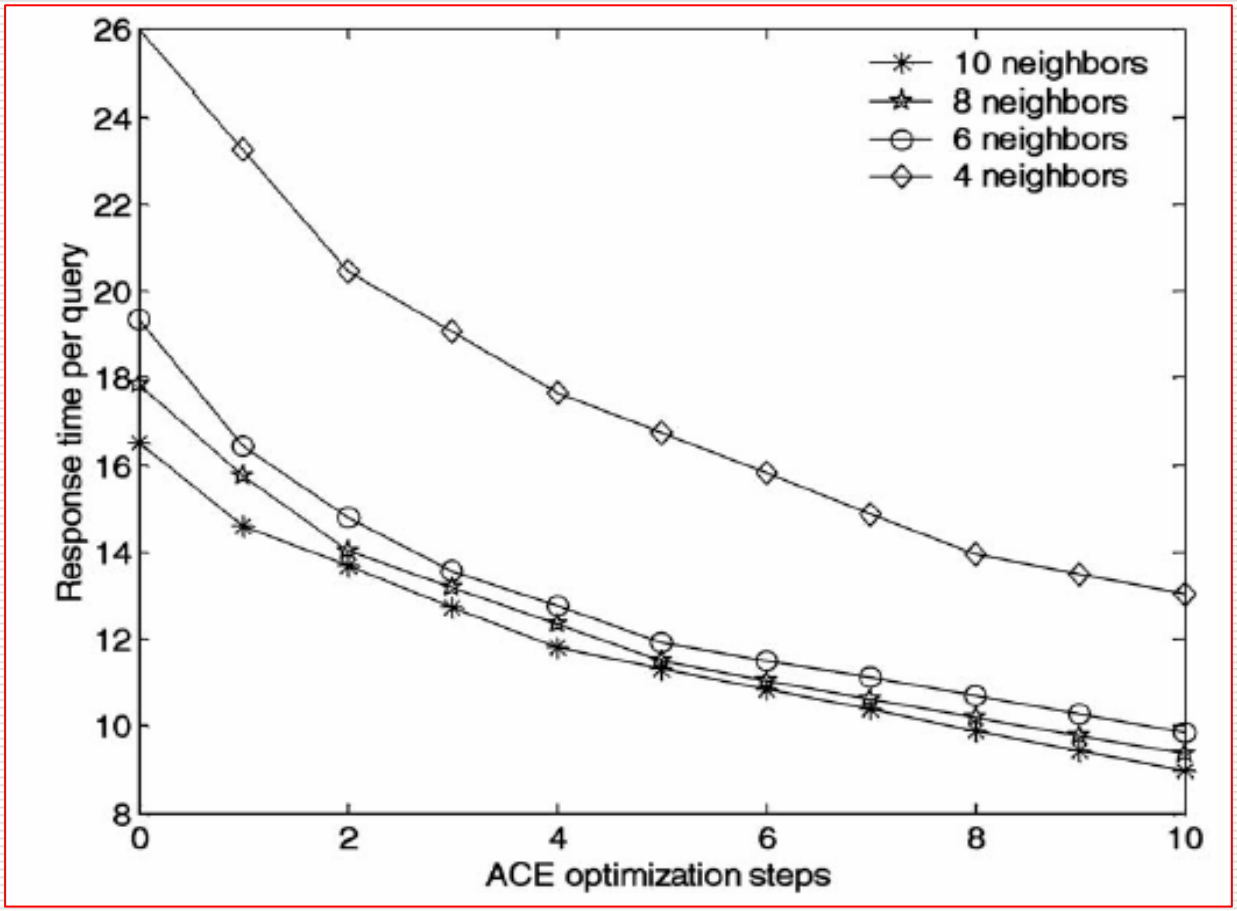
- Overlay (logical) :
  2000~9000 nodes
- Physical :
  27000 Internet-like nodes
- Neighbors :
  4,6,8,10 neighbors

ACE in Static Environment

- Traffic reduction vs. Optimization step

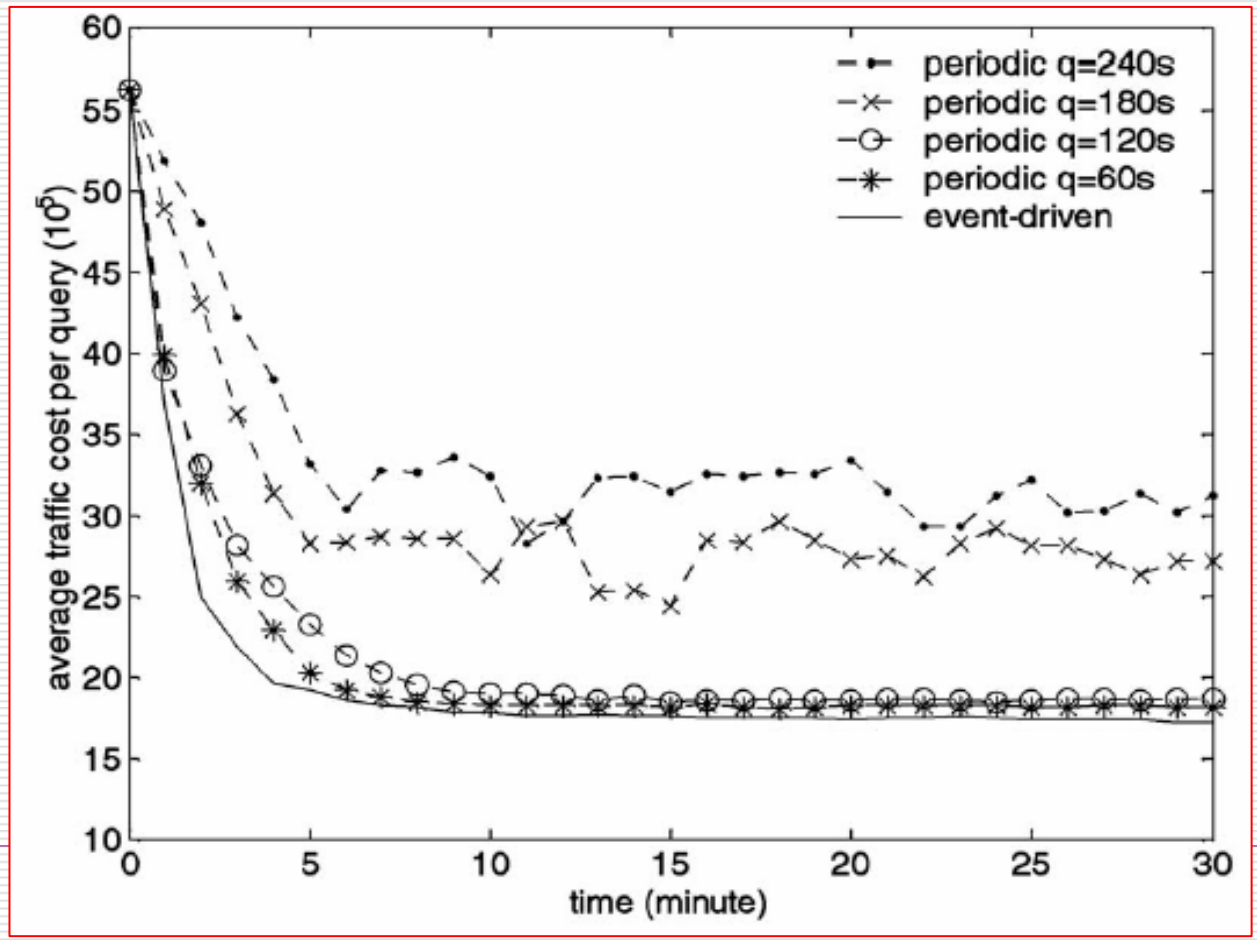


Response time vs. optimization step

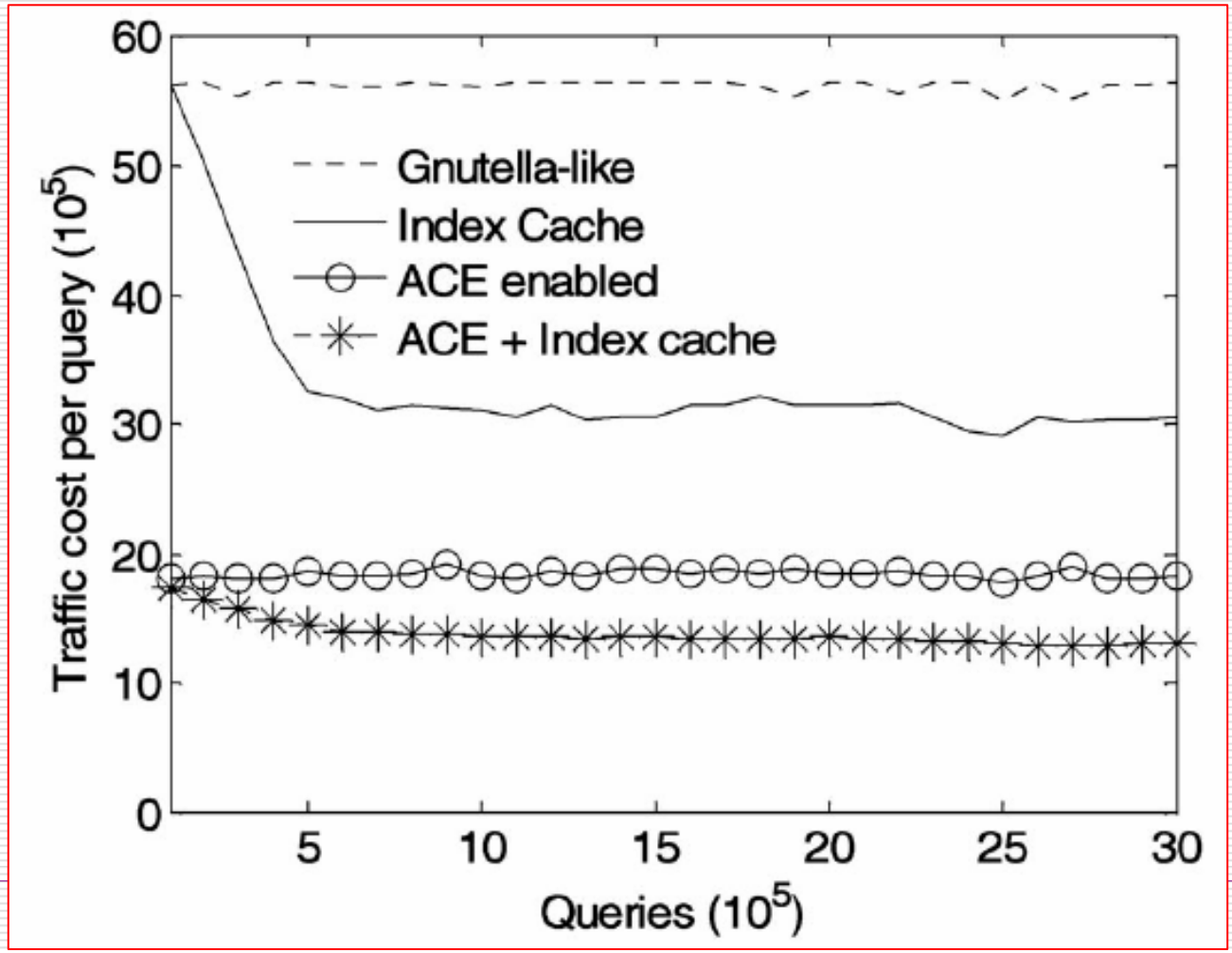


ACE in Dynamic Environment

- Period q effect



Combine with Index Cache



Trade-off : Depth vs. Overhead

Reduce Rate

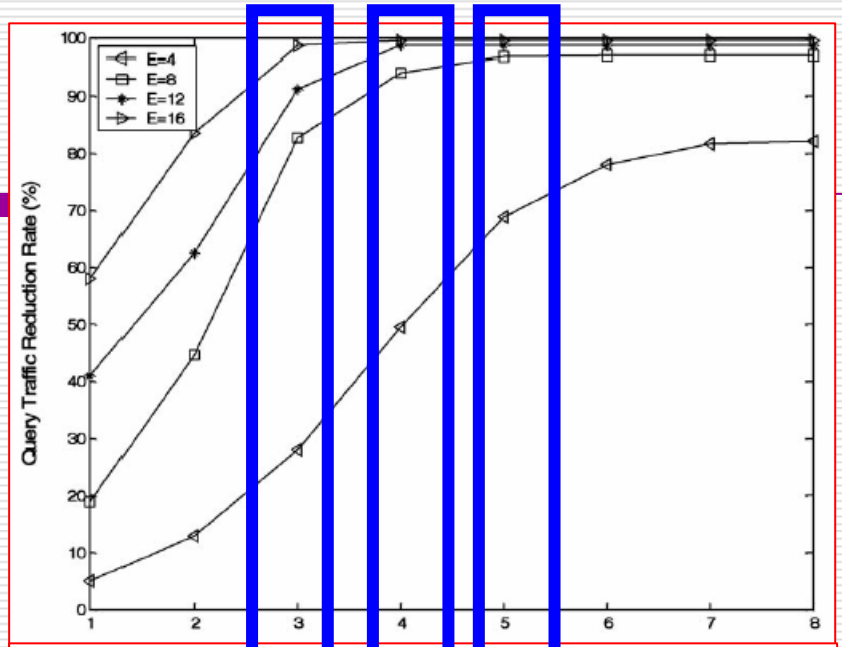


Fig. 19

Overhead

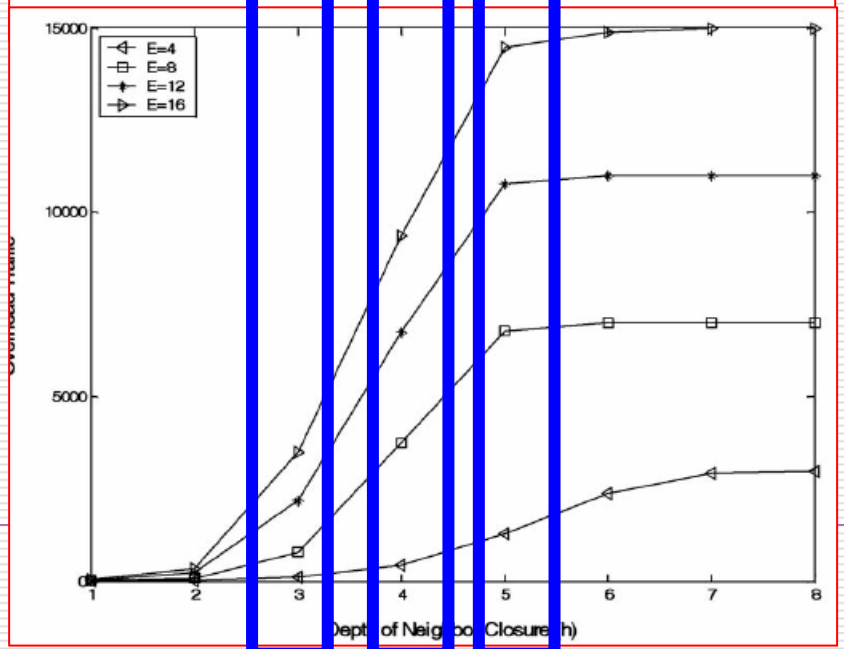
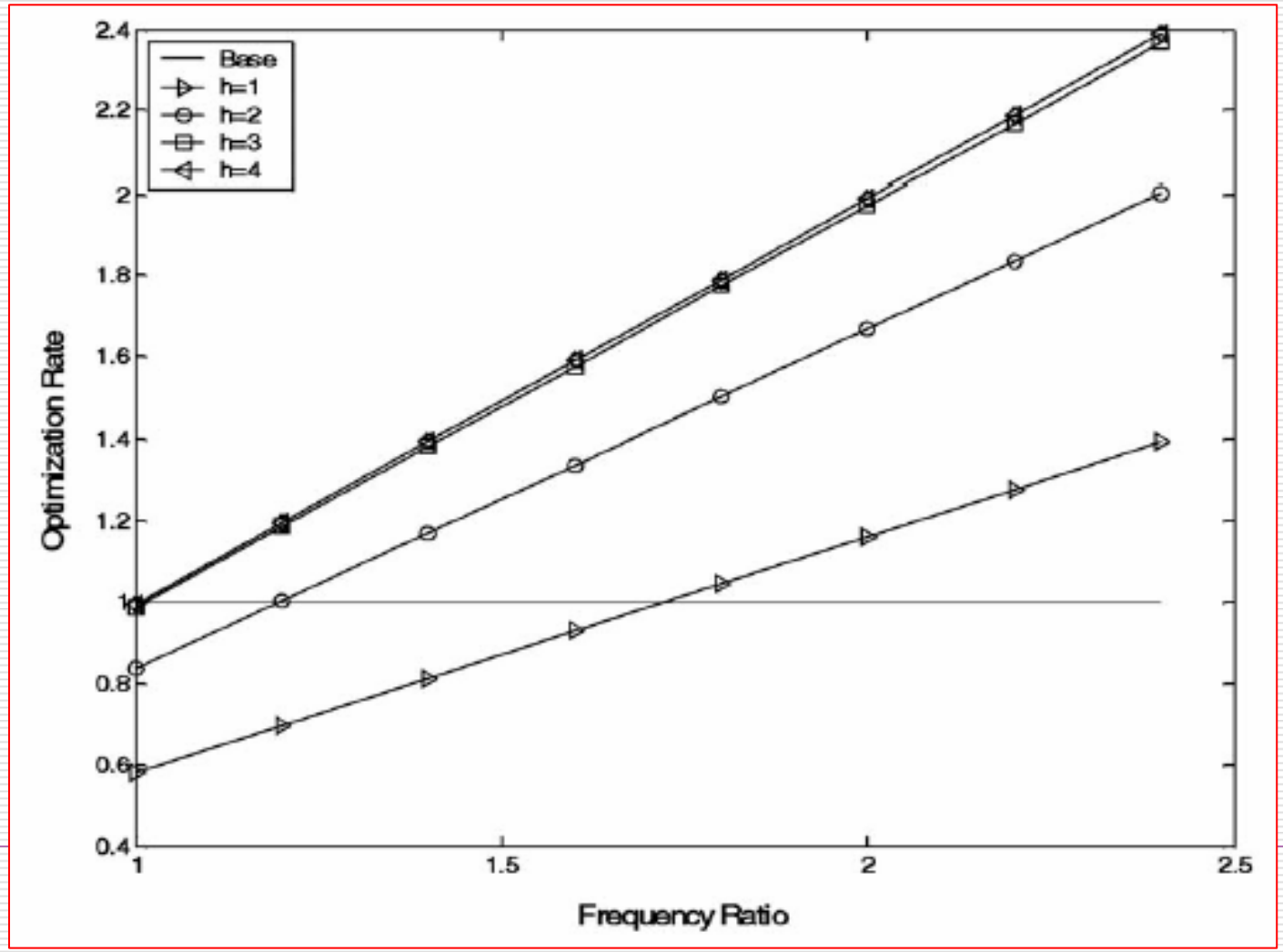


Fig. 20

Optimization rate vs. frequency rate



6. Conclusion

- Using ACE in unstructured P2P system can reduce 65% traffic cost and 35% query response time.
- ACE is more effective in a topology with high connectivity density.
- It will make the flooding-based P2P systems more scalable and efficient.

Reference

- **Location Awareness in Unstructured Peer-to-Peer Systems**

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  Yunhao Liu, Member, IEEE, Li Xiao, Member, IEEE, Xiaomei Liu,

  Lionel M. Ni, Fellow, IEEE, and Xiaodong Zhang, Senior Member, IEEE

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