


# CoolStreaming/DONet

A Data-Driven Overlay  
Network for Efficient Live  
Media Streaming

A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, partially overlapping the text area.

# Outline

- ◆ Other P2P Based Live Streaming Protocols
- ◆ Design of DONet
- ◆ Analysis of Overlay Radius
- ◆ Planet-Based Performance Evaluation

# Other P2P Based Live Streaming Protocols

## ◆ Tree-based Protocols and Extensions

Challenges: construction and maintenance of tree structure overlay

Unbalanced load and Vulnerability

Extensions: Mesh-based tree(Narada, Bullet); multiple distribution trees.


# Other P2P Based Live Streaming Protocols

## ◆ Gossip-based Protocols

Message Redundancy

used for multicast message dissemination; not straightforward for streaming

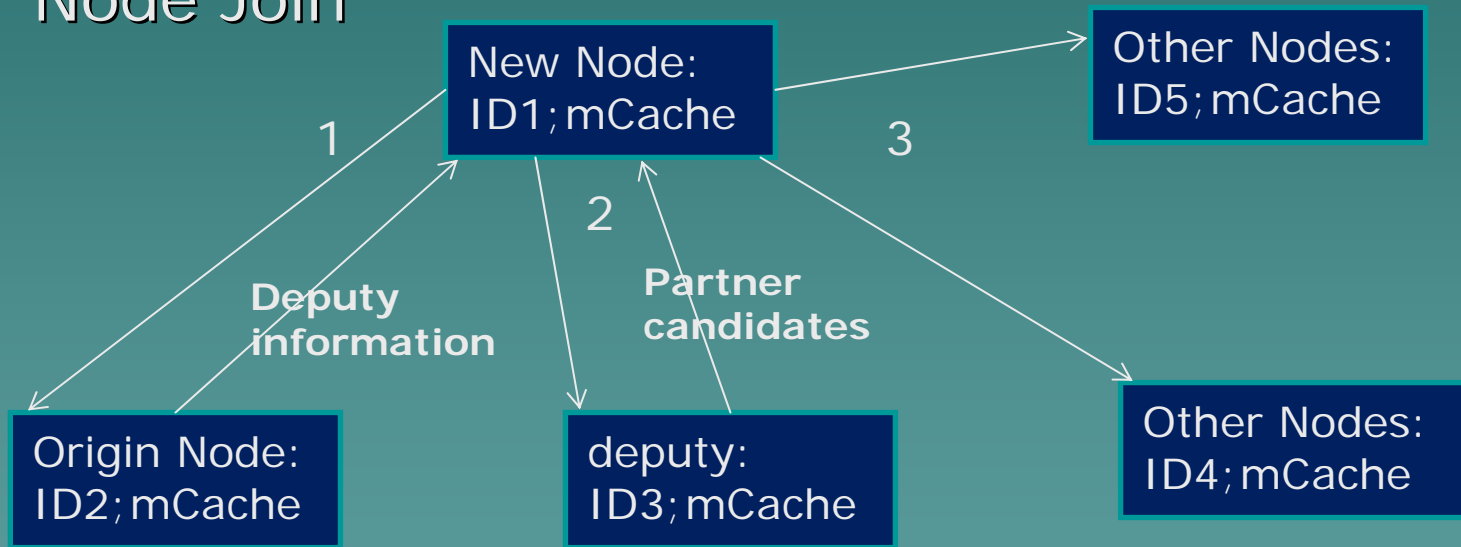
# Design of DONet

- ◆ Membership Management
  - ◆ Scheduling Algorithm
  - ◆ Partnership Management
- 
- A stylized, dark teal silhouette of a mountain range is positioned in the bottom right corner of the slide, adding a decorative element to the background.

# Design of DONet

## ◆ Membership Management

### Node Join



have more uniform partner selections  
minimize the origin nodes' load

# Design of DONet

## ◆ Update of mCache

Membership Message

`<seq_num, id, num_partner, time_to_live>`

period:  $T_1$

Distribution: Scalable Gossip Membership Protocol(SCAM)

node Upon receiving a message:

Update or Create node entry in mCache:

`<seq_num, id, num_partner, time_to_live, last_update_time>`

# Design of DONet

## ◆ Node Departure

departure message

	Graceful departure	Node failure
Who generate	Departing node	Nodes who detect the failure
When	Just before departure	After detecting failure
Message format	Same as Membership message	Same
Distribution Protocol	Same	Same
Specification	Num_partner = -1	Num_partner = -1



# Design of DONet

## ◆ Scheduling Algorithm

Buffermap Representation and Exchange

BM length:

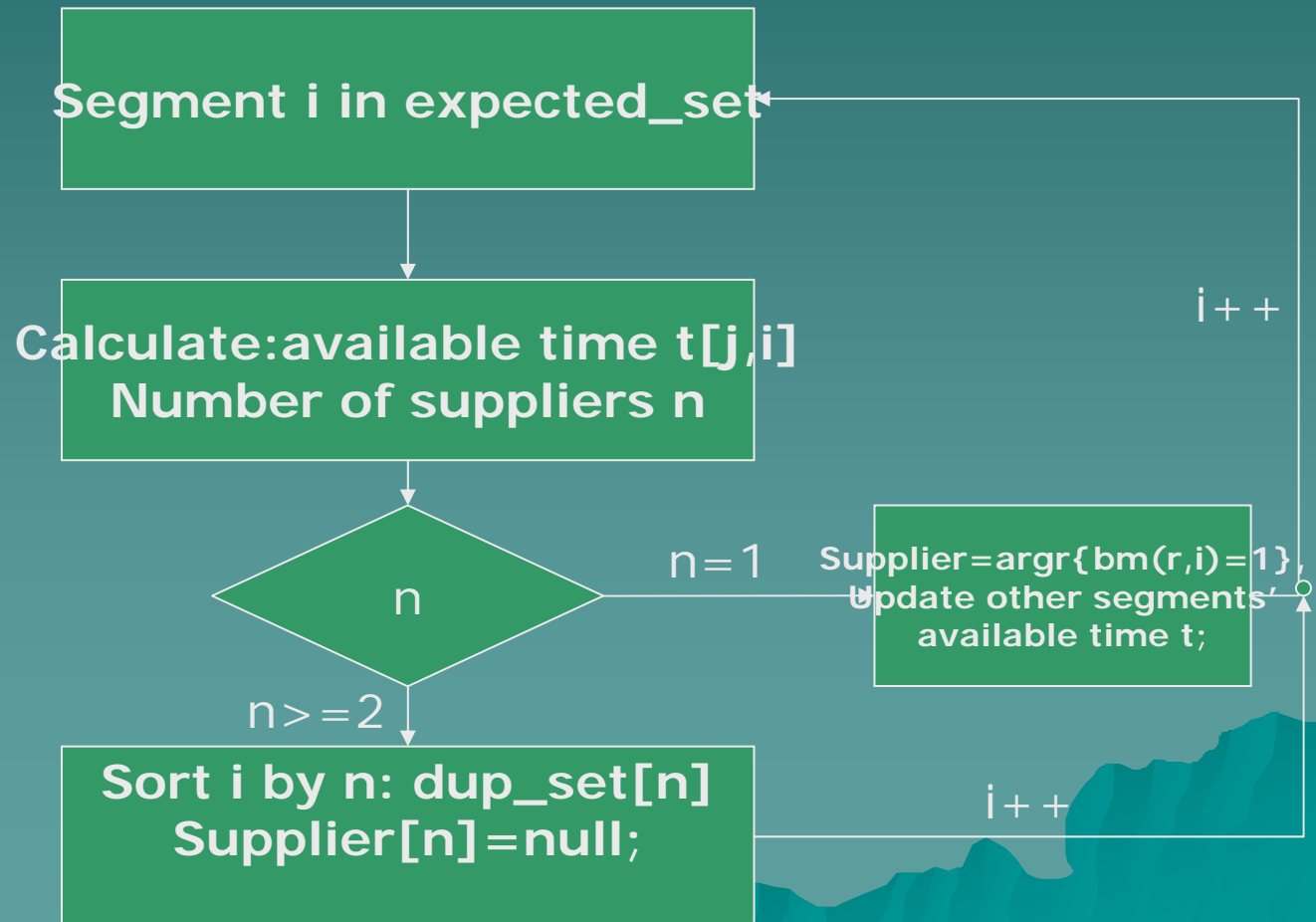
Time lags between nodes:

less than 1 minutes

120 bits for two minutes segment

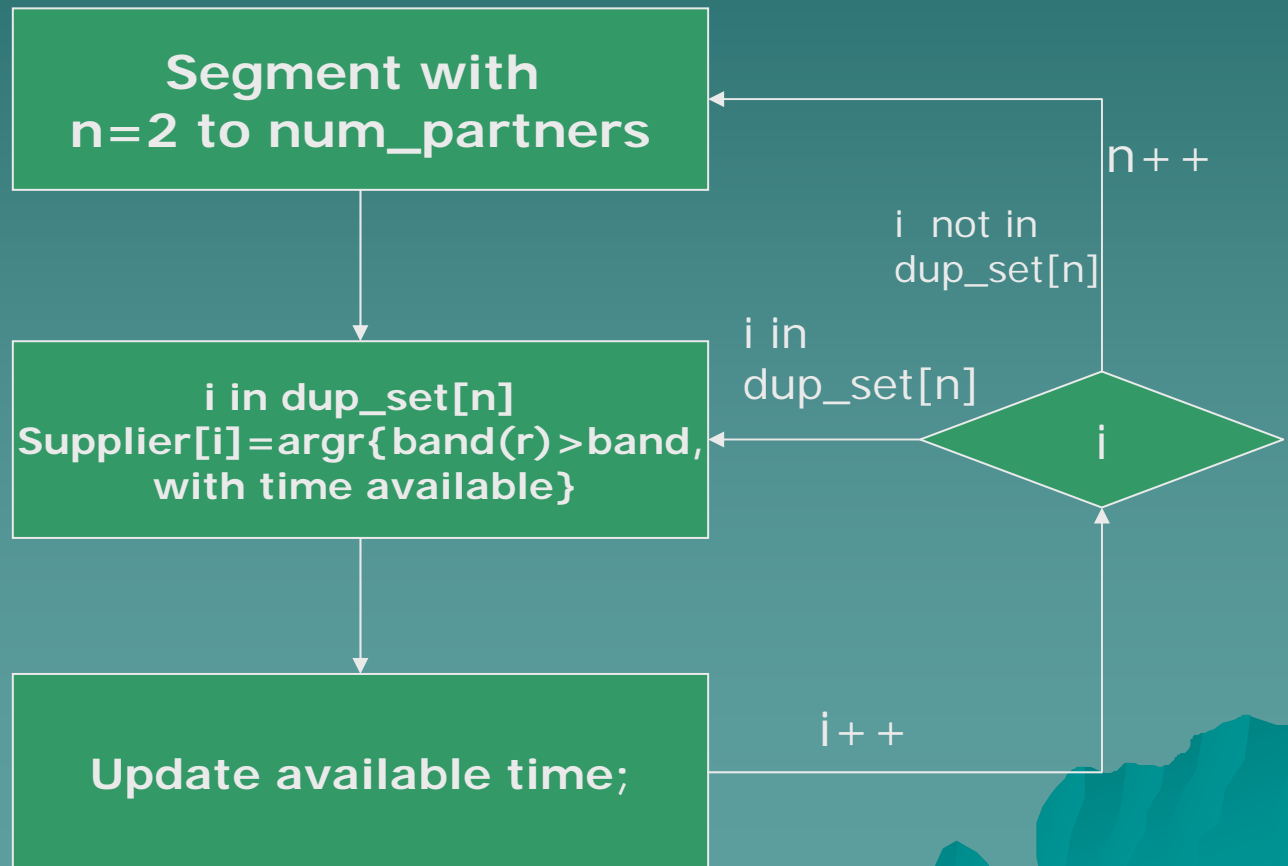
# Design of DONet

## ◆ Scheduling Algorithm



# Design of DONet

## ◆ Scheduling Algorithm



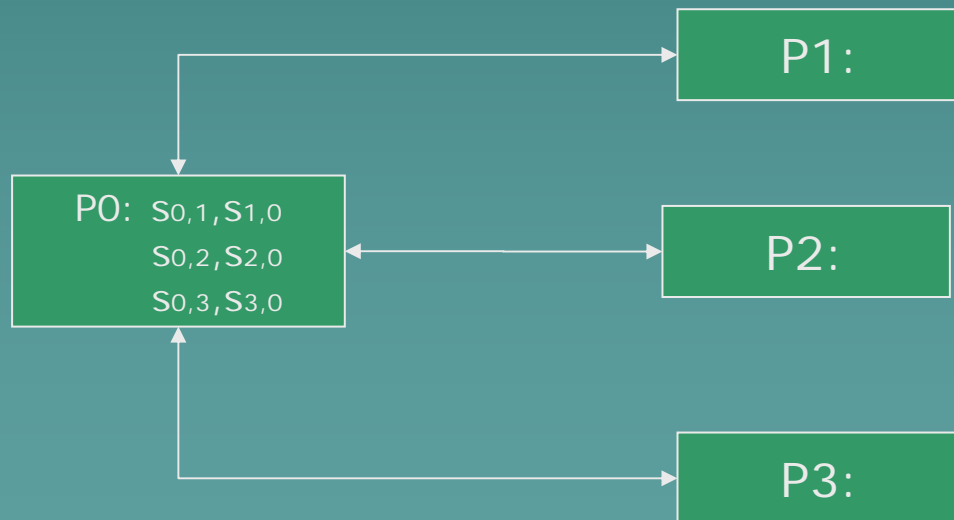
# Design of DONet

## ◆ Partnership Management

periodically establish new partnerships:

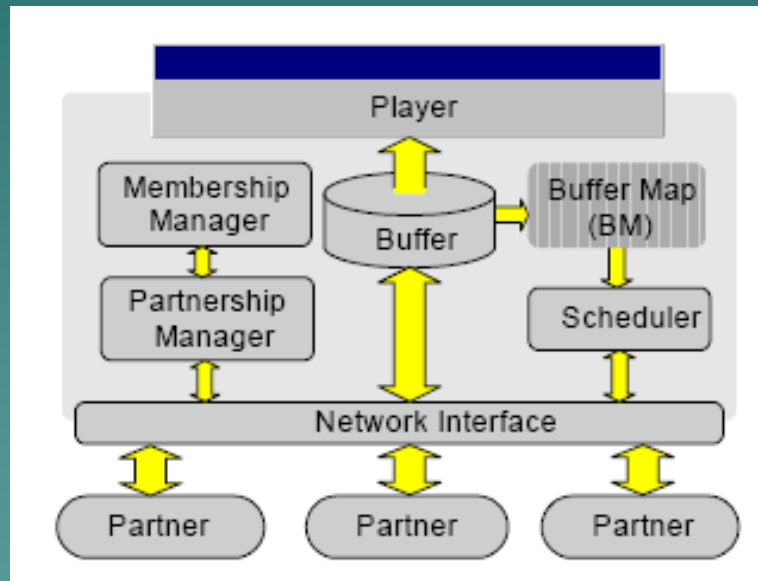
score  $s_{i,j}$ : segments transmitted between  $i,j$

partner with the lowest score will be rejected



# Design of DONet

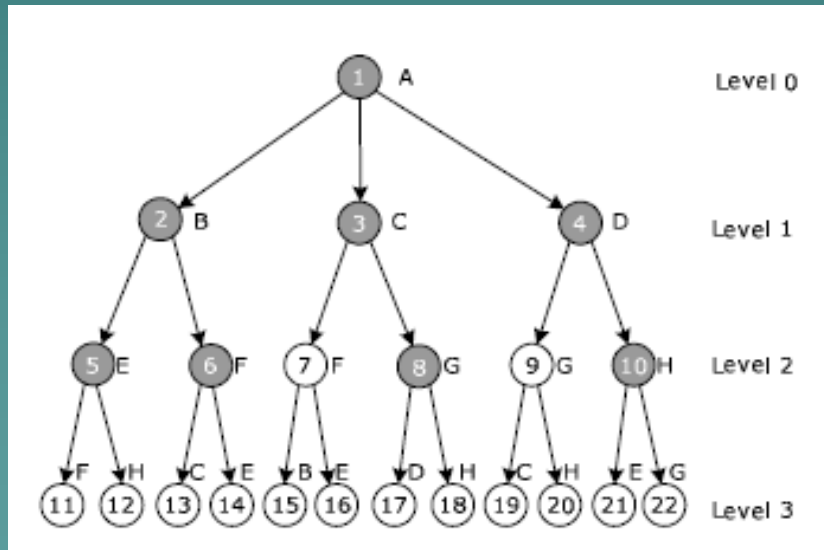
## ◆ System Diagram of a DONet node



# Analysis of Overlay Radius

- ◆ The latency is bounded by  $O(\log N)$

Breath-First-Search Tree: paths propagating segments



$$\delta(t) = \begin{cases} 1, & \text{if } \pi_t \neq \pi_{t'}, 0 < t' < t \\ 0, & \text{otherwise} \end{cases}$$

$$\Pr[\delta(t) = 1] = \frac{N - f(t-1)}{N}.$$

# Analysis of Overlay Radius

- ◆ The total number of unique DONet identifiers associated with s-nodes 1 through  $t$ :  $f(t)$

$$f(t) - f(t - 1) = \delta(t)$$

Calculating the average of  $f(t)$ :

$$E[f(t) - f(t - 1)] = E[\delta(t)] = \frac{N - E[f(t - 1)]}{N}$$

$$E[f(t)] = 1 + \frac{N - 1}{N} E[f(t - 1)]$$

$$E[f(t)] = N[1 - (\frac{N - 1}{N})^t] > N(1 - e^{-\frac{t}{N}})$$

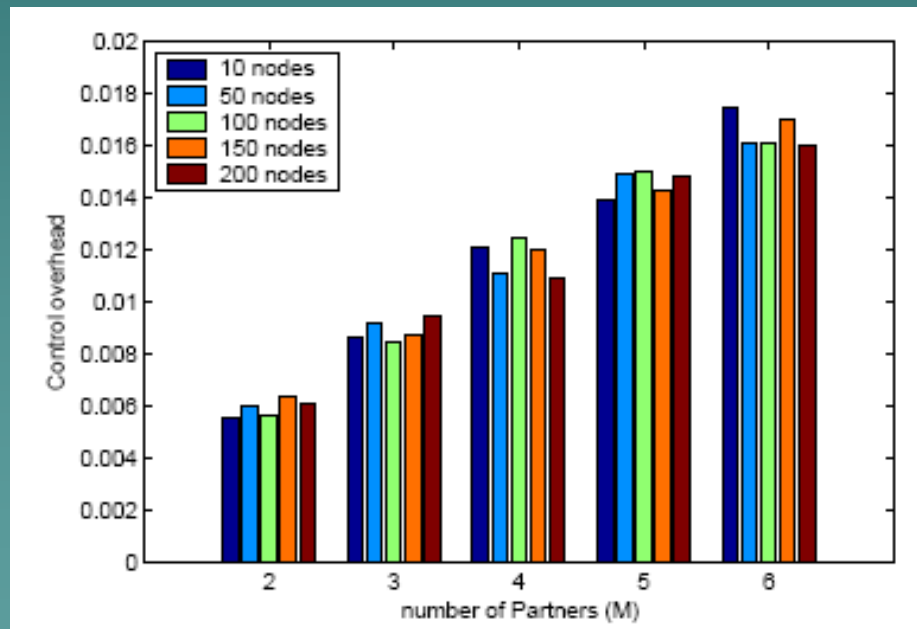
$$d = \frac{1}{N} \sum_{k=1}^{\infty} k \cdot E[f(t_k) - f(t_{k-1})]$$

# Planet-Based Performance Evaluation

## ◆ Performance under Stable Environment

Control overhead:

$\text{Control Overhead} = \text{Control traffic volume} / \text{Video traffic volume}$



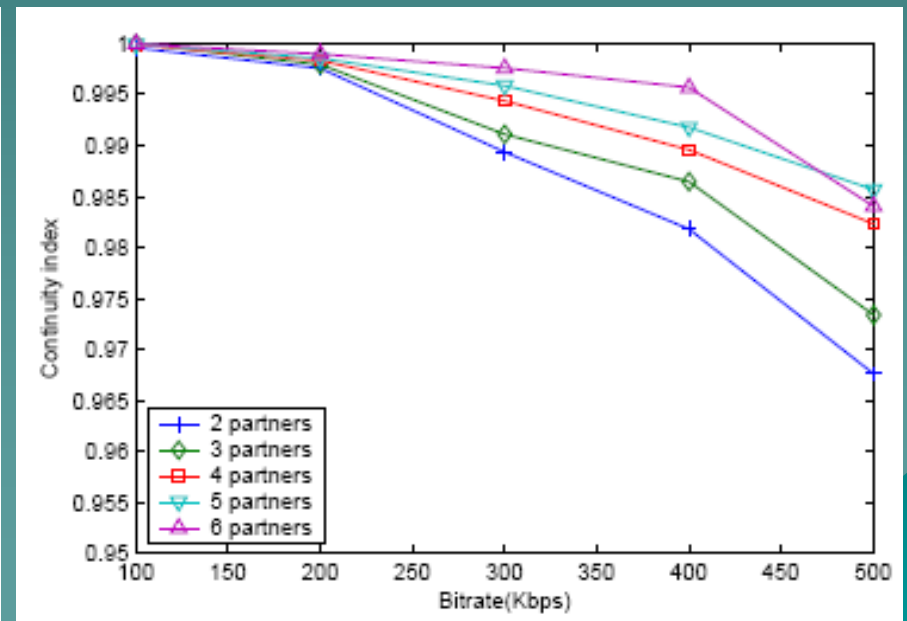
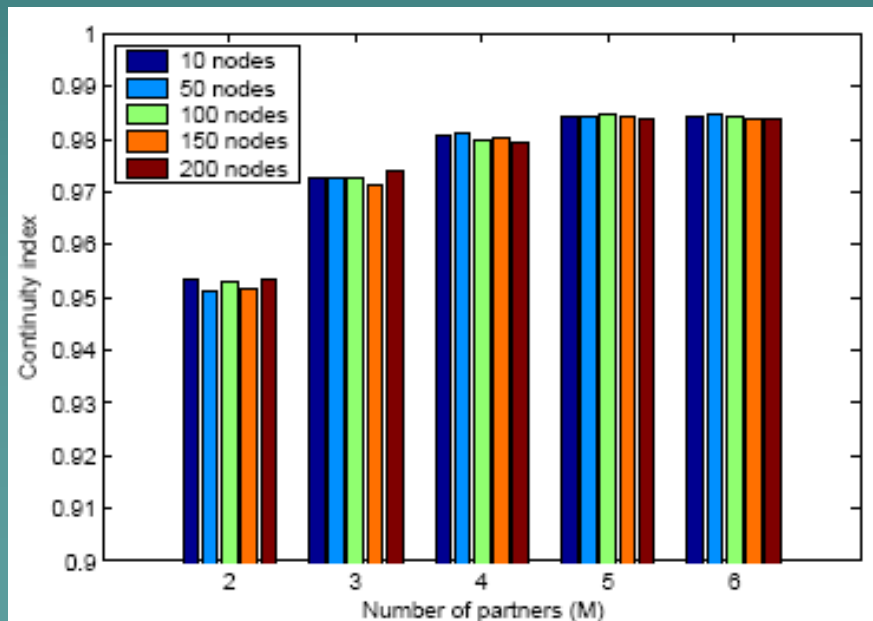


# Planet-Based Performance Evaluation

## ◆ Performance under Stable Environment

Playback continuity:

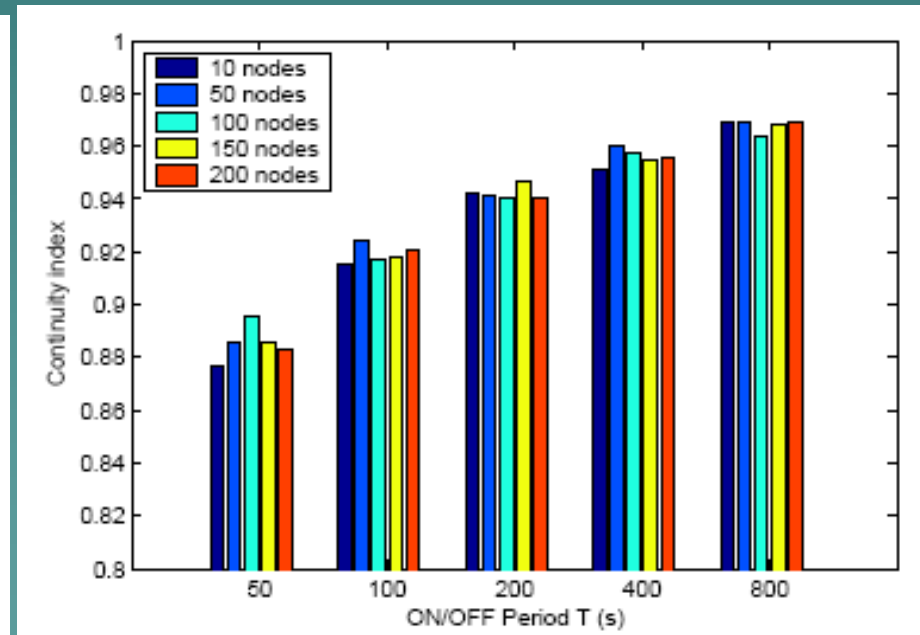
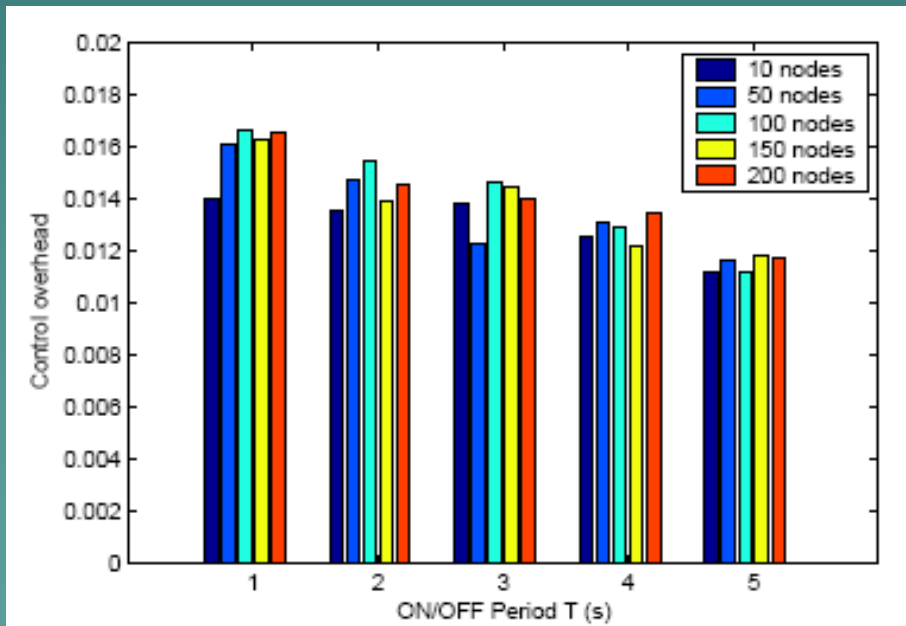
Continuity index =  $\frac{\text{number of segments arriving on or before deadline}}{\text{total number of segments}}$



# Planet-Based Performance Evaluation

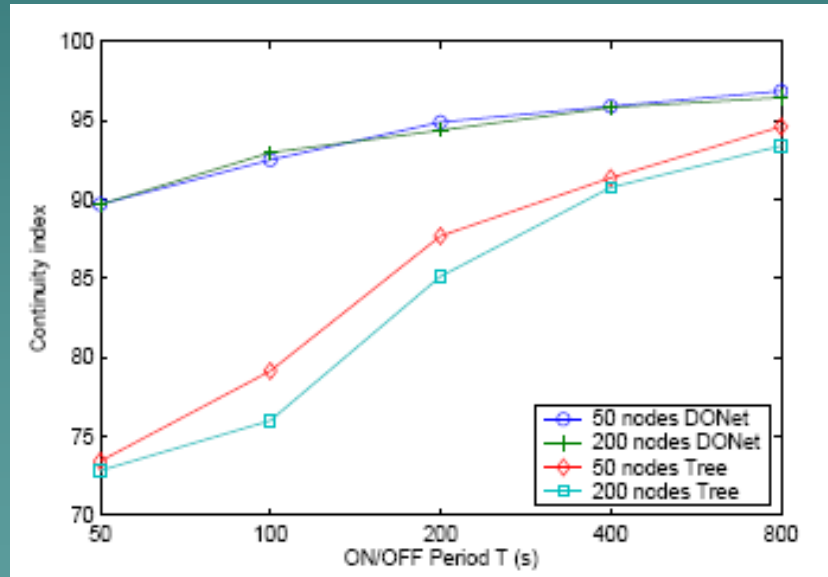
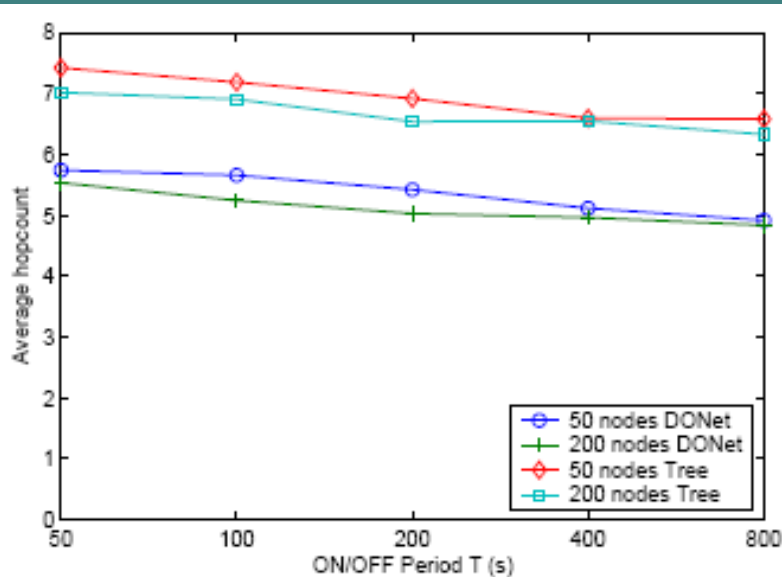
## ◆ Performance under Dynamic Environment

On/Off model: each node changes its status: participate in on period and leave in off period



# Planet-Based Performance Evaluation

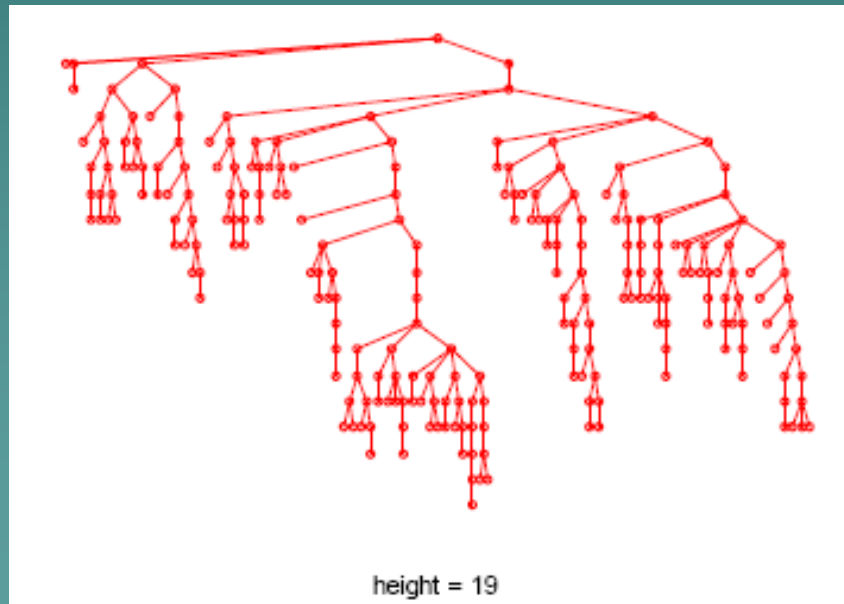
## ◆ Comparison with Tree-Based Overlay



# Planet-Based Performance Evaluation

## ◆ Comparison with Tree-based Overlay

Due to unbalanced load, tree-based overlay often couldn't achieve a shorter delay



Thank you!

