A Hybrid Video Streaming Scheme on Hierarchical P2P Networks

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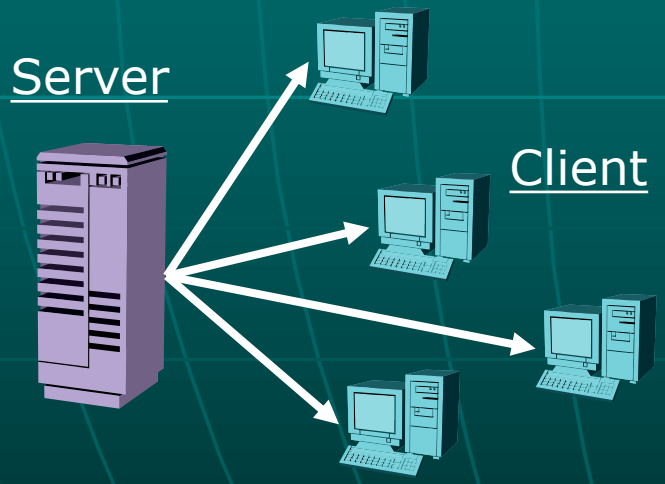
Overview

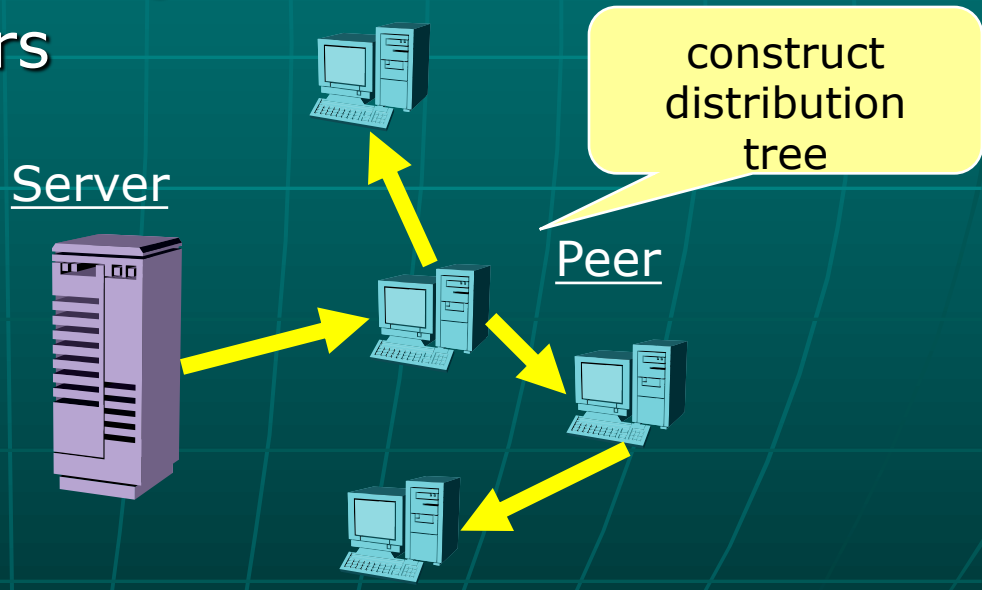
- Research background
- Objective
- Proposed scheme
  - Scheduling algorithm
  - Tree construction mechanism
  - Fault recovery mechanism
- Simulation experiments
- Conclusion & future work

Research Background (1/2)

- Increased popularity of video streaming
  - streaming: to decode while downloading
  - distribution of movies or news
- Development of P2P technology
  - distribute video streaming with P2P multicast
  - reduce load of servers



Client-server model



P2P multicast

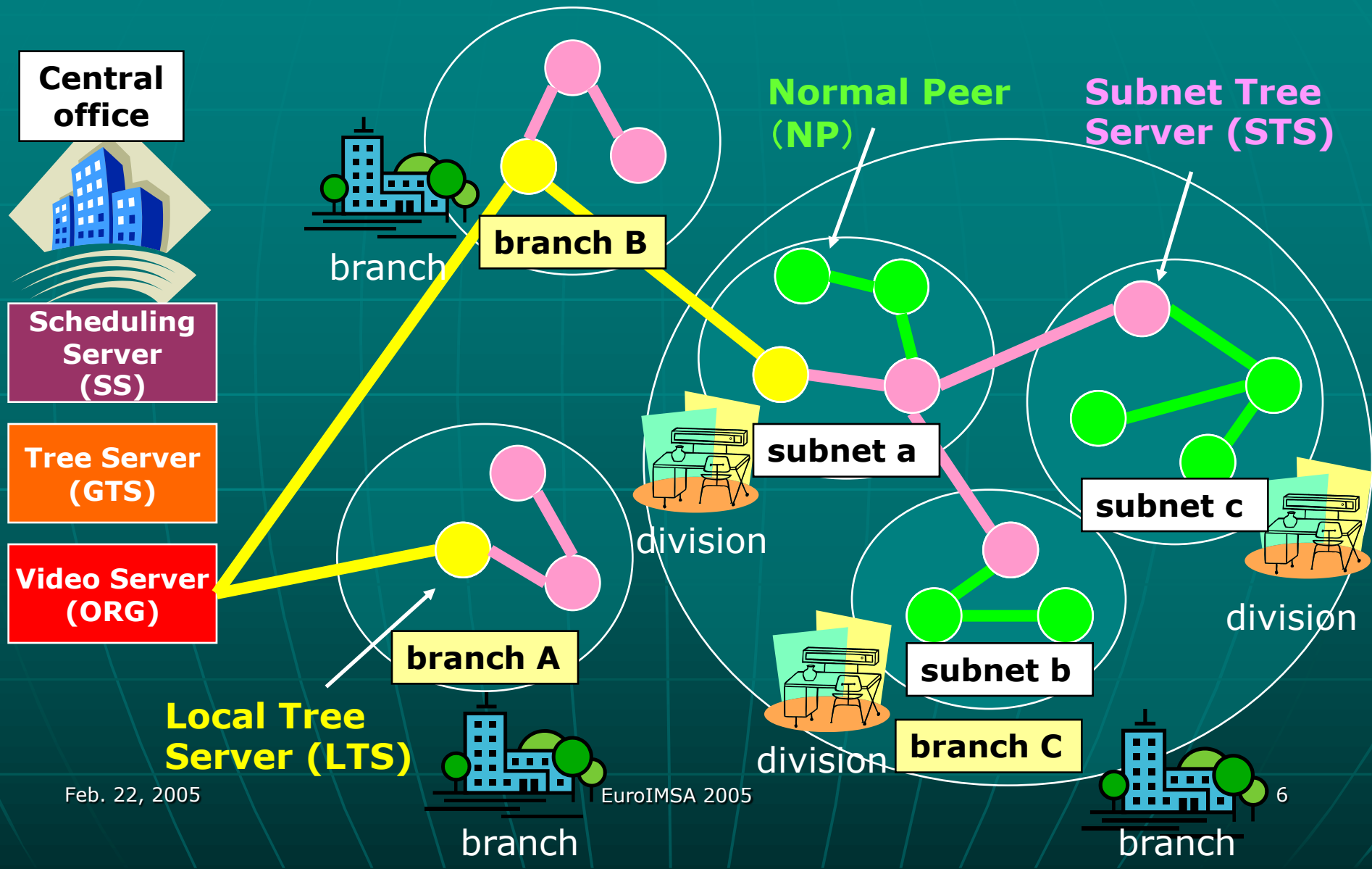
Research Background (2/2)

- How to construct “good” distribution trees?
  - one way is to measure characteristics of physical networks, such as delay or bandwidth
    - requires long time
    - causes heavy load
  - enterprises or universities: well-organized networks are constructed
    - branch networks or division networks
    - no need to measure characteristics
    - construct distribution trees easily and quickly

Objective

- We propose a hybrid video streaming scheme for…
  - networks hierarchically constructed based on organization structure
  - networks with thousands or ten thousands of users
- Objective of our proposal
  - reduce load of servers
  - reduce load of networks
    - avoid connecting between long-distance peers
    - avoid using a link repeatedly for a flow
  - reduce initial waiting time until video starts playing
  - reduce freeze time caused by faults

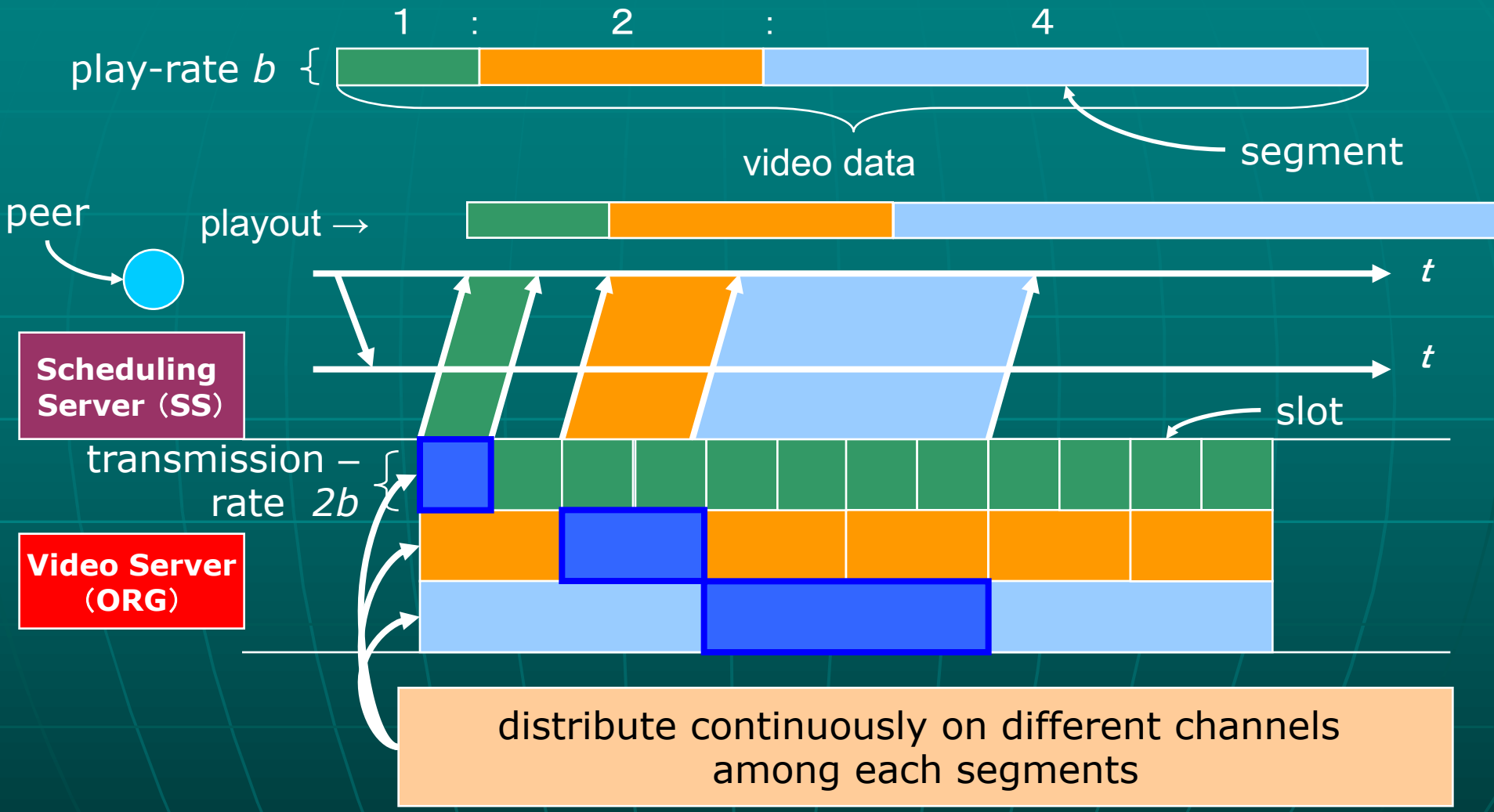
Overview of Proposed Scheme



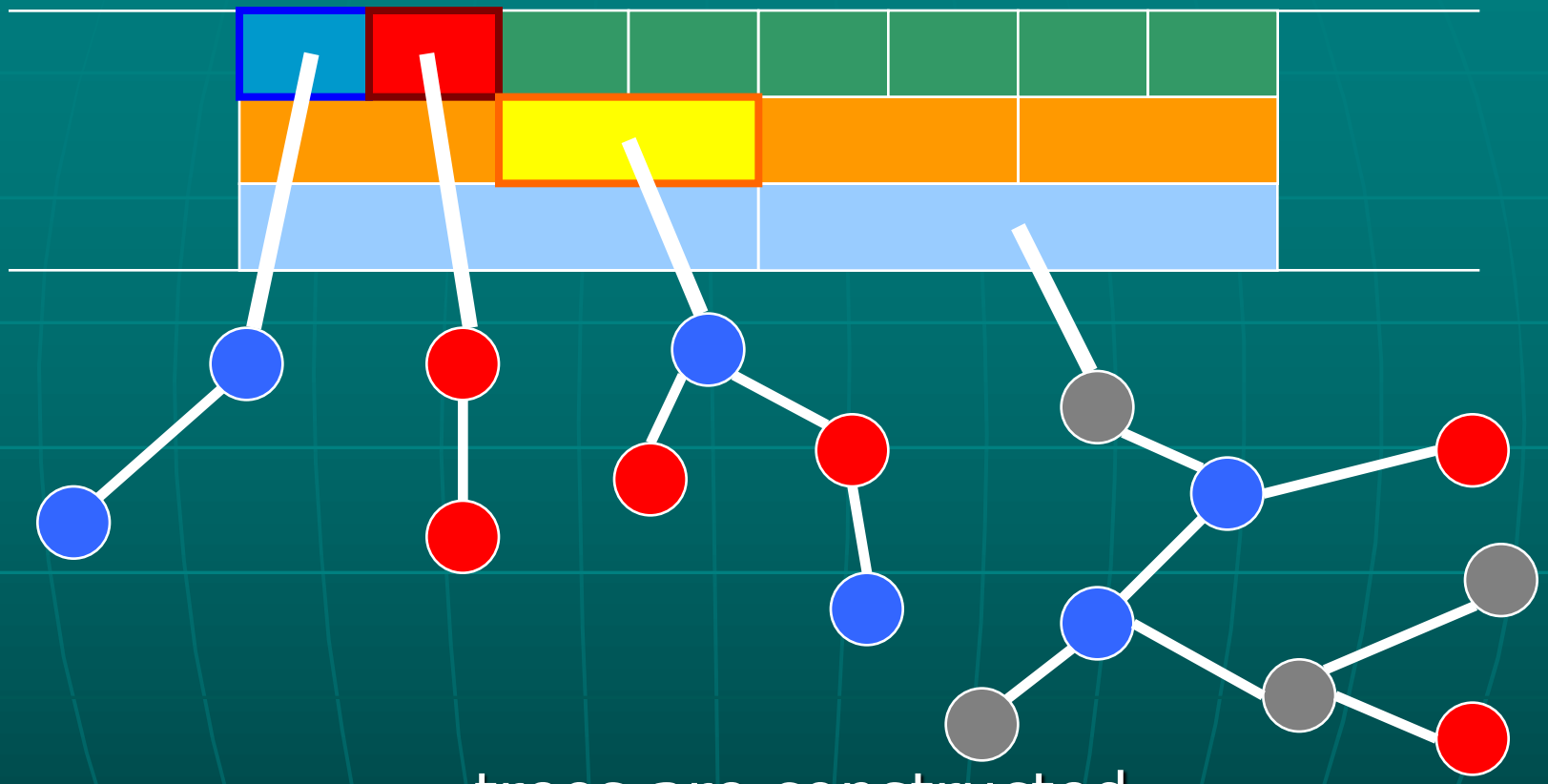
Outline of Proposed Scheme

1. Scheduling algorithm
   - use “pyramid broadcasting”
     → reduce initial waiting time until video starts playing
2. Tree construction mechanism
   - construct P2P multicast trees
     → reduce load of servers
   - make networks hierarchical based on physical structure
     → reduce load of networks
3. Fault recovery mechanism
   - recover from faults rapidly with only local communication
     → reduce freeze time caused by fault

1. Scheduling Algorithm
- pyramid broadcasting -



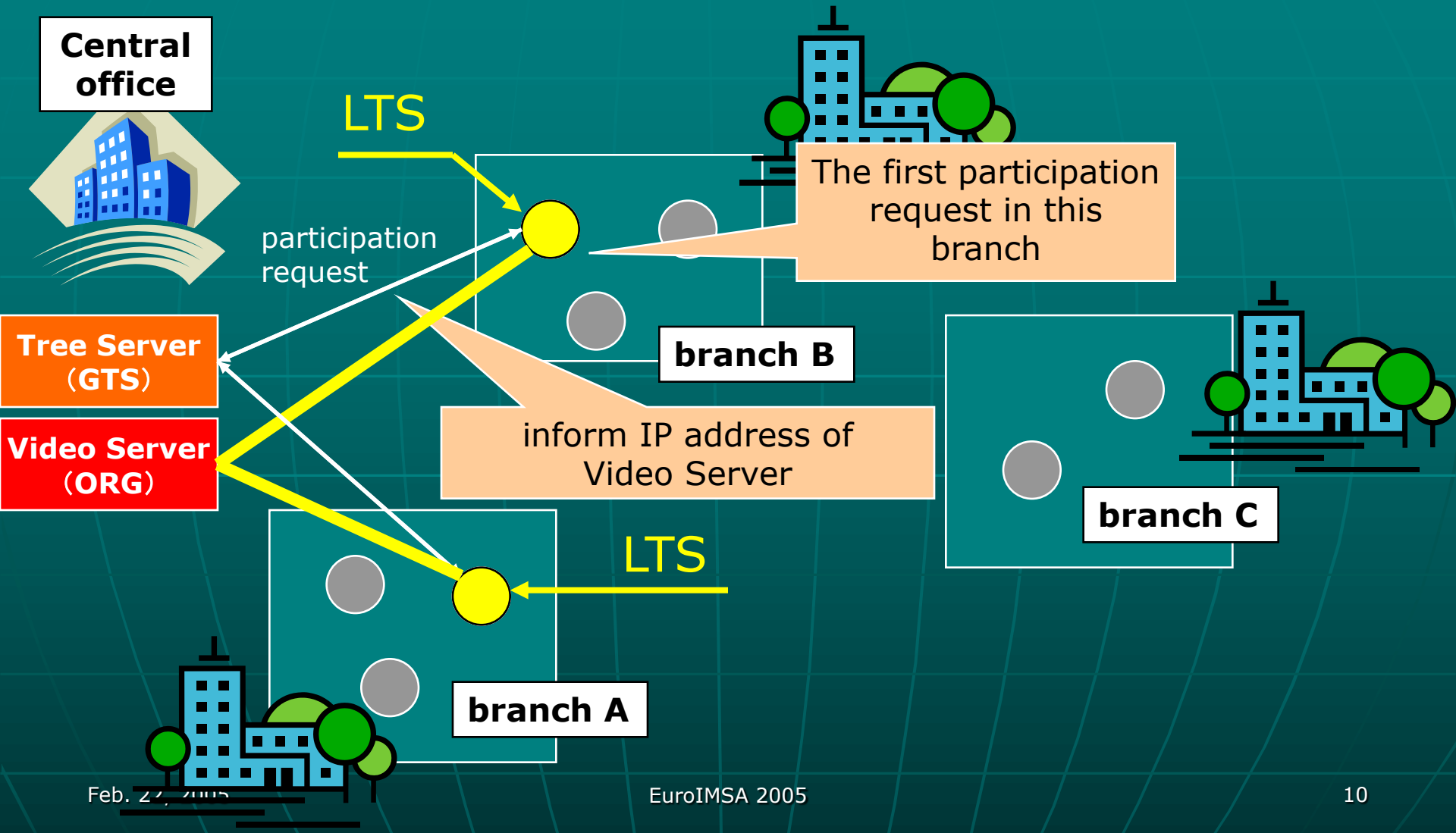
2. Tree Construction Mechanism



trees are constructed
segment-by-segment and slot-by-slot

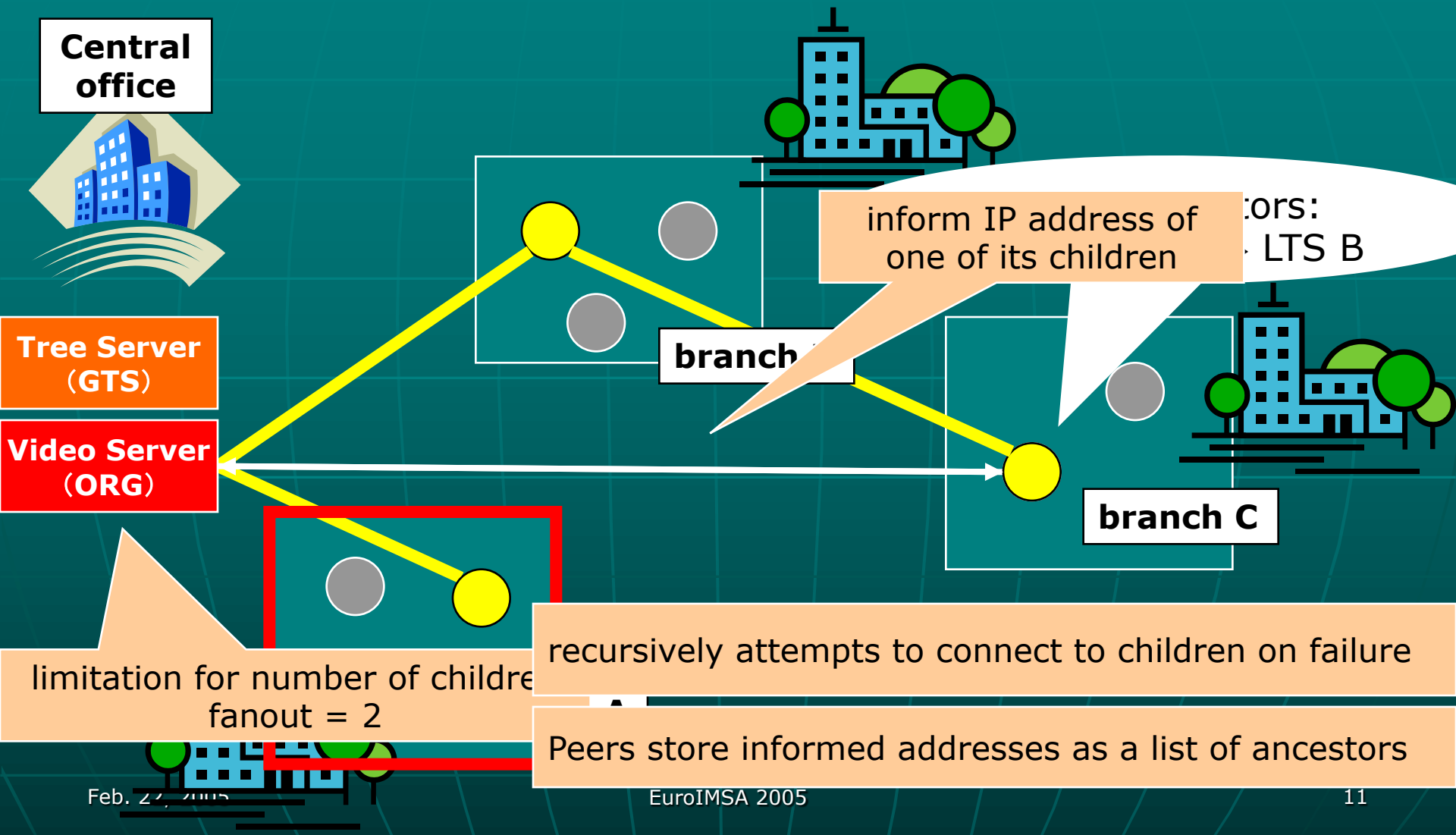
2. Tree Construction Mechanism

- inter-branch tree -



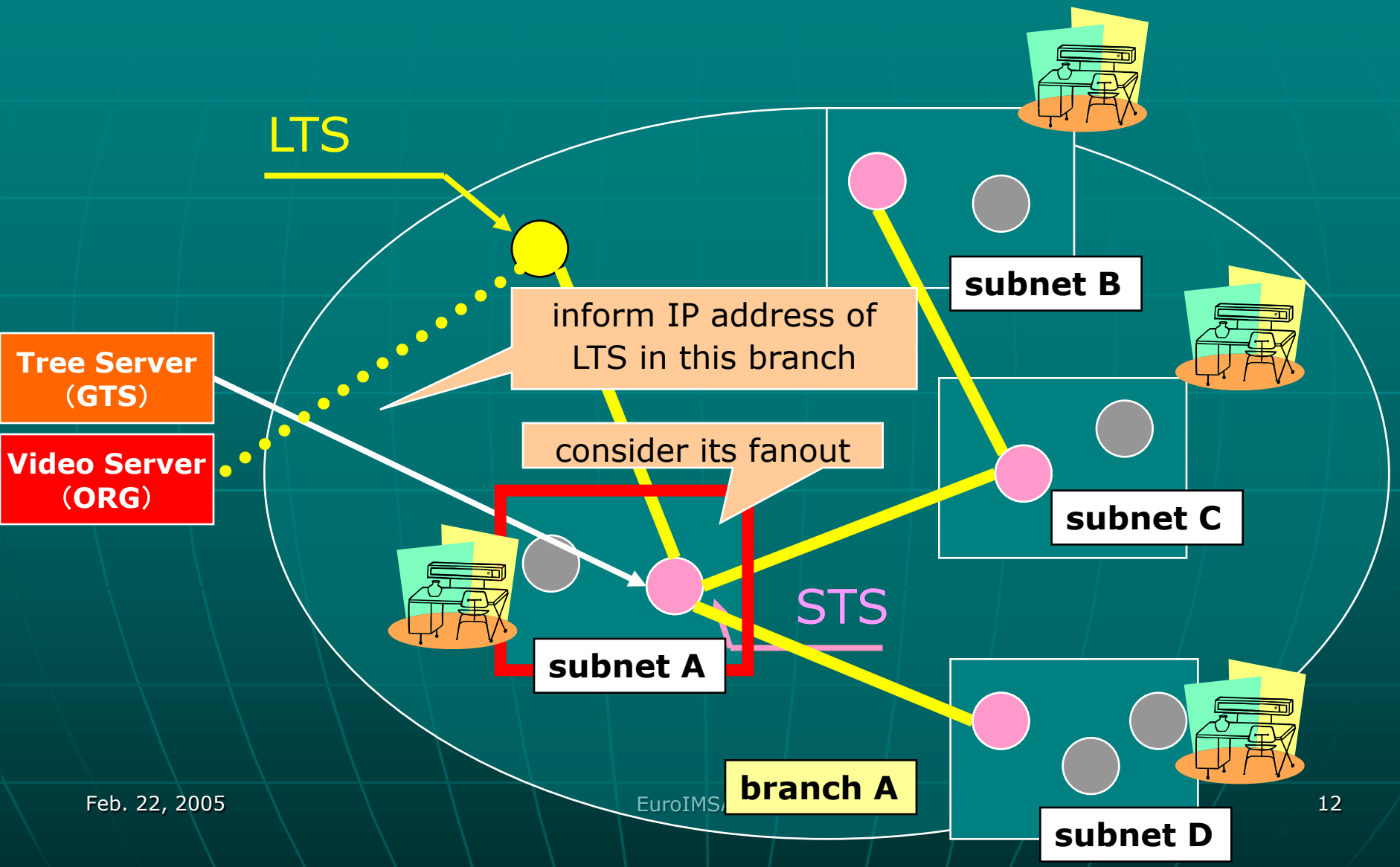
2. Tree Construction Mechanism

- inter-branch tree -



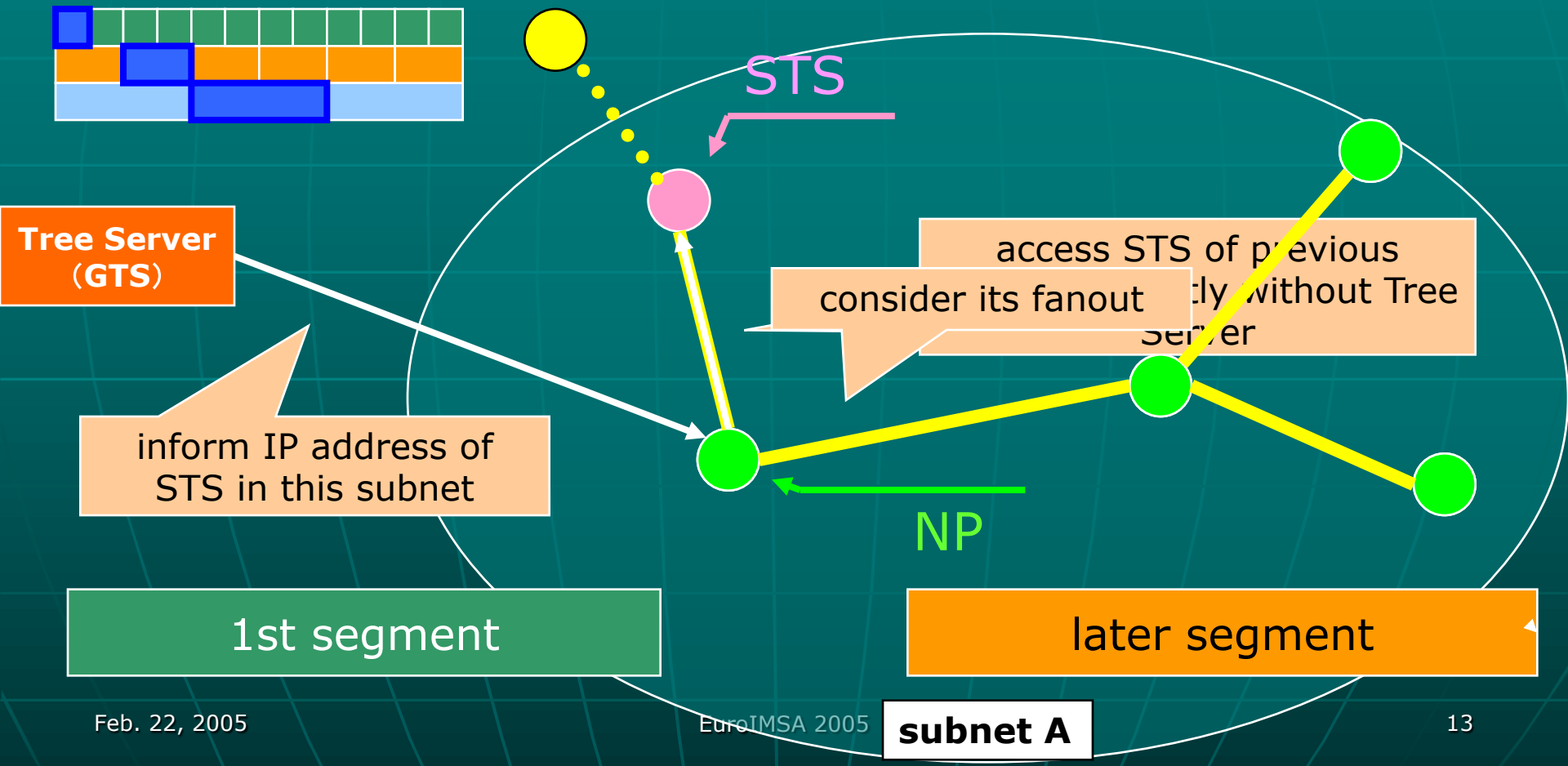
2. Tree Construction Mechanism

- inter-subnet tree -



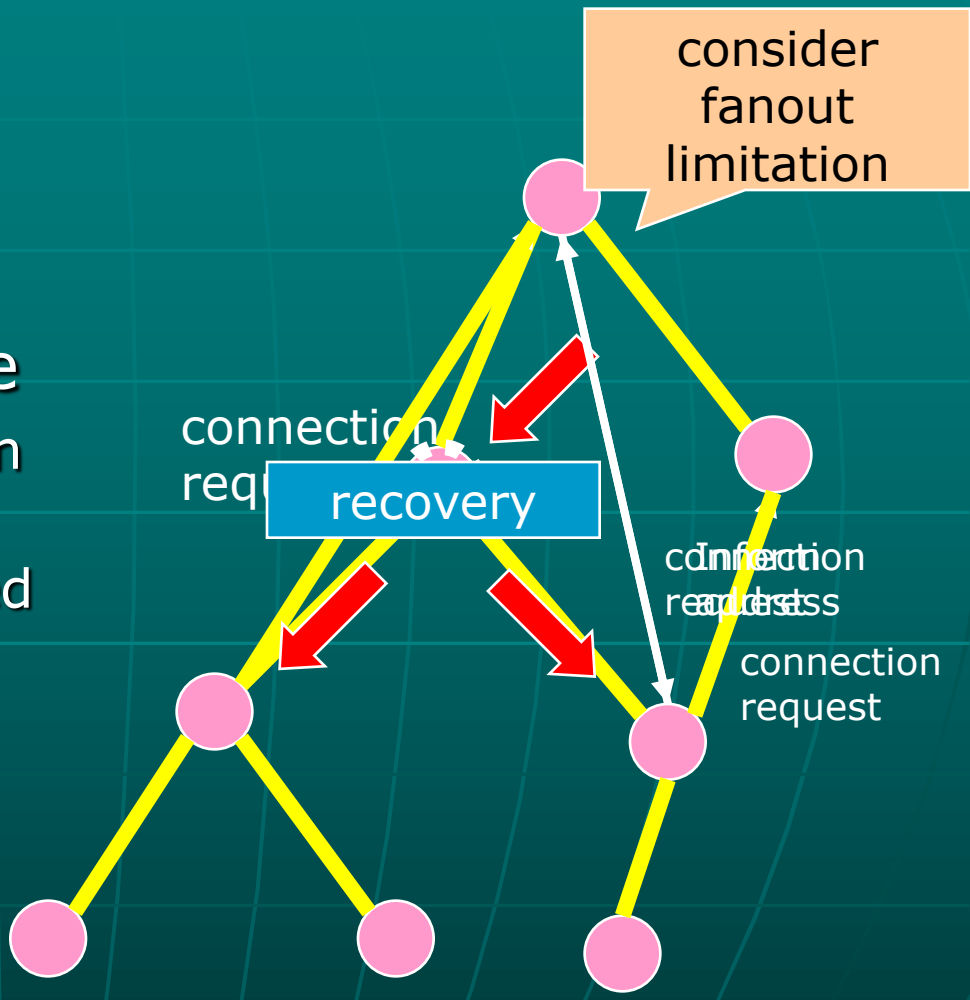
2. Tree Construction Mechanism
- inter-NP (Normal Peer) tree -

- difference between 1st and later segments



3. Fault Recovery Mechanism
- recovery within subtree -

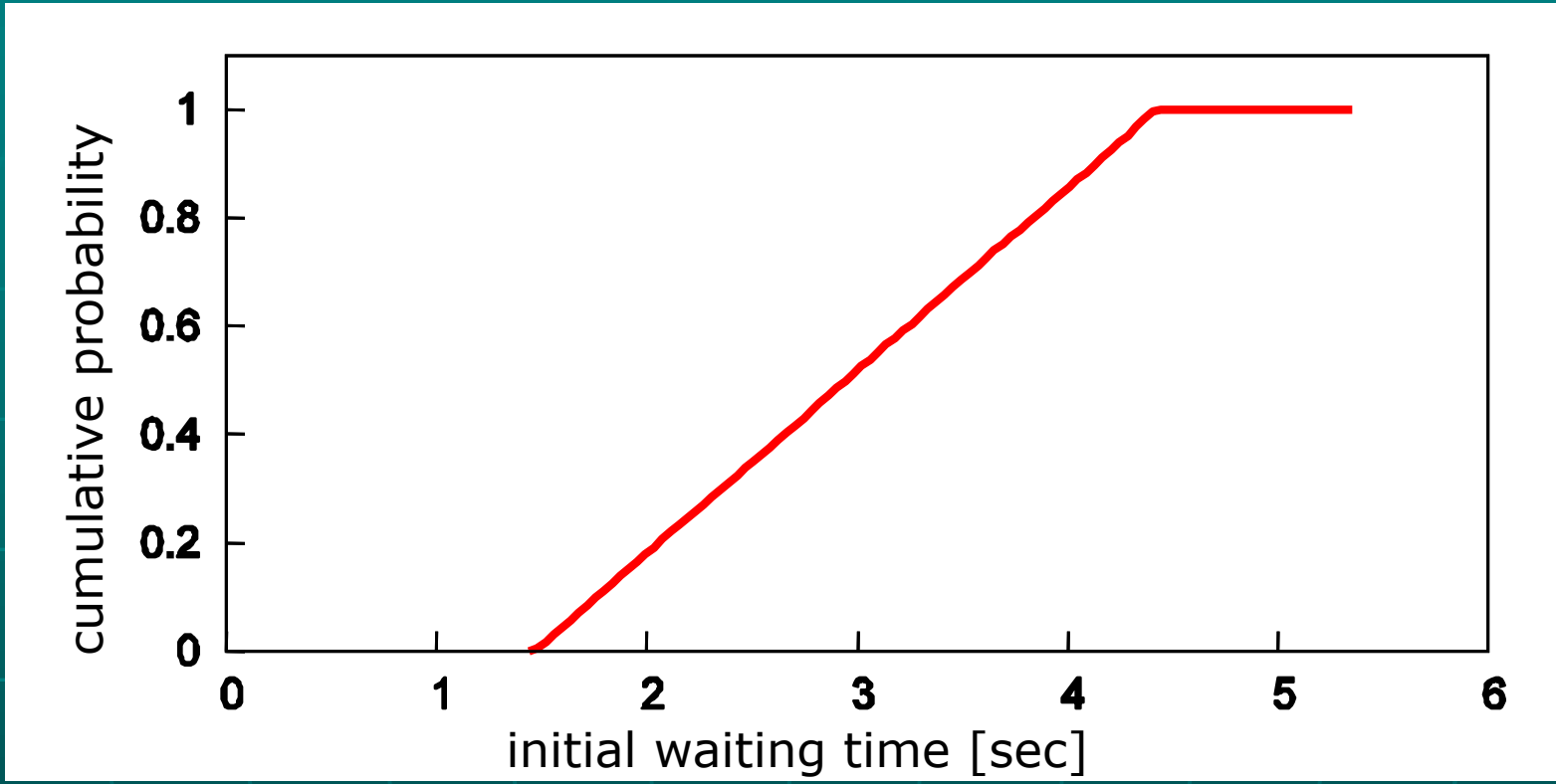
- Fault:
  - peer leaves network
    - variety of reasons
    - different occasions
- Recovery within subtree
  - each peer has information about ancestors
  - mechanism can be applied in the same manner to:
    - inter-branch trees
    - inter-subnet trees
    - inter-NP trees



Simulation Experiments

- Evaluation criteria
  - load of servers and peers
  - initial waiting time
  - recovery and freeze time
- Scenario
  - 5 branches and 5 subnets in a branch
  - peer arrival process: uniform, average: 30 [arrivals/sec]
    → average total number of peers: 2,790
  - transmission delay between server and peer: 200 [ms]
  - transmission delay between peers: 20 [ms]
  - fanout degree: 3
  - fault probability: 0.004
    (= 47% for correctly receiving the whole video)
  - video duration: 186 [sec]
  - number (lengths) of segments: 5（6, 12, 24, 48, 96 [sec]）

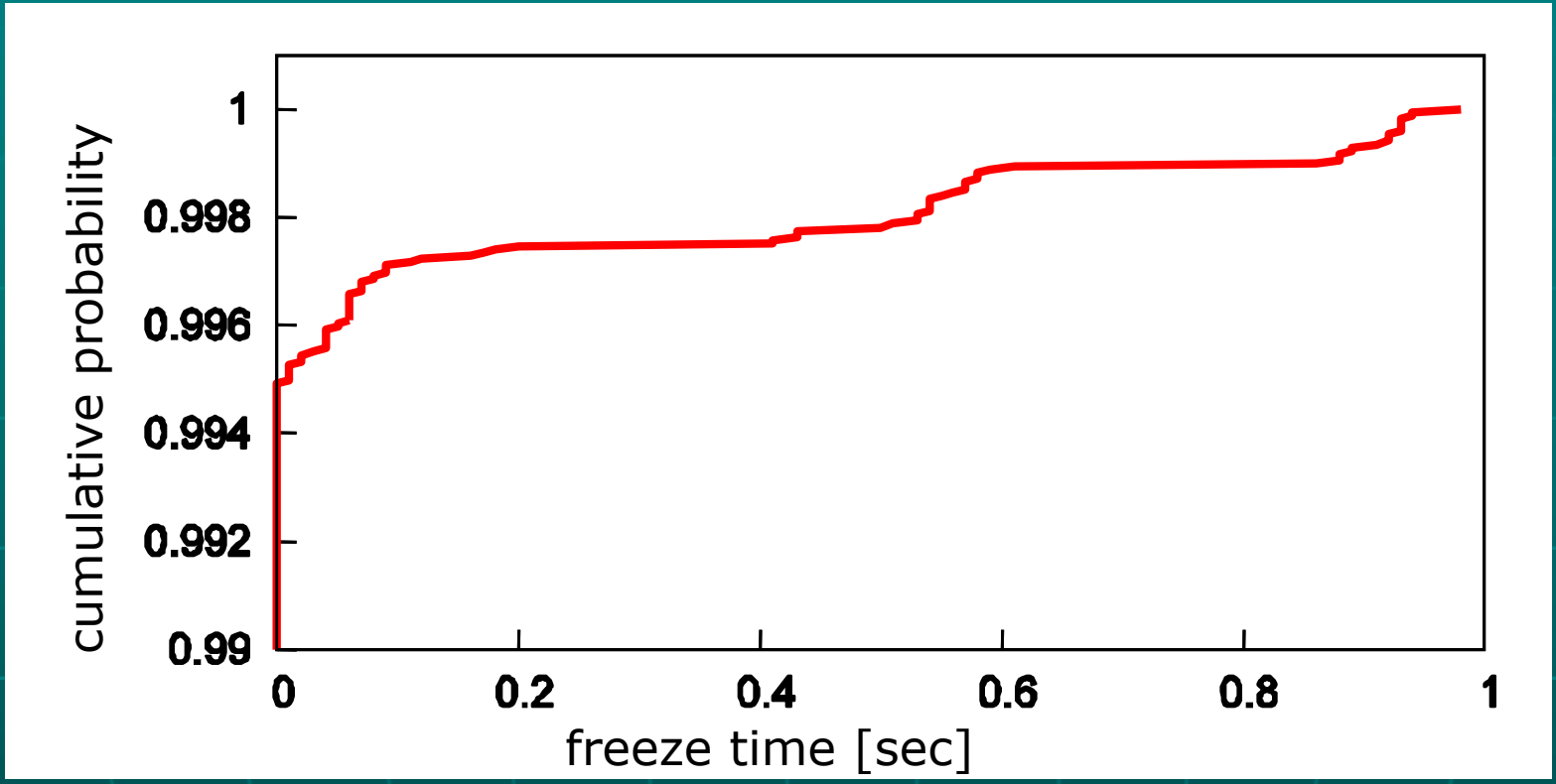
Initial Waiting Time



average waiting time: 2.94 sec

maximum waiting time: < 6 sec

Freeze Time



video freezes for only 0.5 %
of all thousands of peers
maximum freeze time: < 1 sec

Conclusion & Future Work

- Proposal of video streaming distribution scheme
  - Scheduling algorithm
  - Tree construction mechanism
  - Fault recovery mechanism
  - Reduction of initial waiting time and freeze time
- Extensions
  - Further reduction of load on the tree server
  - Optimization of tree structures to eliminate long-distance redundant links

- Thank you.