A Survey and a Proposed Approach on Robust Tree Overlays

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Focus

Proposed Approach: AETOS, the Adaptive Epidemic Tree Overlay Service
Tree Structures

Simple in principal

Aggregation

Search

Information Dissemination

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Tree Overlays and Distributed Systems

Sensitive

Node failures

Congestions

Link failures

Attacks

Heterogeneity

Sensitive

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Central Approaches

- Unscalable and not an option for every type of application
- Disregarded in this survey
General Approach for Reliable Trees

Application Optimization

Self-organization

Fault-tolerance

Maintenance

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Related Surveys

- Focus on one application scenario, e.g. Application Level Multicast
- Classify and examine methods according to the cross-link, in-tree or multiple-tree redundancy
- Tree vs. mesh based systems

A Survey on Robust Tree Overlays

22 recent related papers

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Aspects of Investigation

- Application type
- Performance metrics
- Complementary overlay
- Build and maintenance
- Decentralization level
- Proactiveness vs. Reactiveness
Application Type

Crucial in most of the self-organization approaches

One-to-many communication model, efficient information dissemination, low communication cost

Application Level Multicast


Distributed databases


Publish-subscribe, grids, sensor networks


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Performance Metrics

- Delay
- Bandwidth
- Node degree
- Uptime


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Complementary Overlay Support

- **Mesh**
  - Y. Li and W. T. Ooi. Distributed construction of resource-efficient overlay tree by approximating MST. In ICME, pages 1507–1510, 2004

- **Extra links**

- **Gossiping**

- **DHT**

- **Central Entities**
  - Evangelos Pournaras, June 2009
Build and Maintenance

Joins, shifts-up and swaps

- B. Akbari, H. R. Rabiee, and M. Ghanbari. DPOCS: A Dynamic Proxy Architecture for Video Streaming Based on Overlay Networks. In IEEE MICC & ICON '05, 11 2005

Eager and lazy push gossiping strategies


Bellman Ford, Prim’s algorithm


Proactive Maintenance, repair strategies

Decentralization Level

Most illustrated approaches are distributed
Self-organizing tree overlays with autonomous nodes

- Hybrid systems
  - Overlay Control Server (OCS)
  - Multicast Server Node (MSN)
  - Content Server
  - Backbone system
  - Super-nodes


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Proactiveness vs. Reactiveness

Proactive level 1: Support from an underlying overlay


Proactive level 2: Sorting the nodes according to performance metrics


Proactive 3: Know beforehand the neighbor to connect to in case of failure


Reactive level 1: detect failures and reconnect (heartbeats)


Reactive level 2: swaps and shifts-up operations during build

- B. Akbari, H. R. Rabiee, and M. Ghanbari. DPOCS: A Dynamic Proxy Architecture for Video Streaming Based on Overlay Networks. In IEEE MICC & ICON ’05, 11 2005

Reactive level 3: Reactive level 2 in dynamic environments


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Discussion and Open Issues

- Peer-to-peer tree overlays can enable the effective utilization of a wide range of application types.
- Robustness is related to the environment and the application type.
- Generic tree overlay (service) for different application types?
- Underlying overlays should enhance the effectiveness of trees and not move their vulnerabilities.
- Bridging and gap and unifying proactiveness and reactivity.
Why do I investigate tree overlays?

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Why do I investigate tree overlays? (cont.)

Energy Management

Stabilization of energy consumption

How?

Aggregation and decision-making over a tree overlay

Questions?