Dynamic Aggregation of Reservations for Internet Services

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- Management Architecture DARIS
- Dynamic Aggregation
- Dedicated Signaling Support
- Simulation Results
- Conclusion and Outlook

End-to-End QoS Management: Approach

- Quality-of-Service based on DiffServ Architecture
  → scalability in data path
- Some services require admission control from end to end
  (e.g., EF-based services)
  → resource management required
- Dedicated resource manager per DiffServ domain
  - routers are relieved from burden of control processing
    (no need to be involved in admission control decisions)
  - support for managing persistent states
    (e.g., policy or accounting data)
- Objective: Integrated Management Architecture
  - providing services on demand
  - admission control from end to end
  - resource management within a domain
  - integration of provider policy aspects and AAA solutions
  - support for mobile users and group communication
Inter-Domain QoS Signaling

- End-to-End QoS-based services on demand require admission control per flow (esp. inter-domain)
  → scalability problems in control plane (states, messages)
- Inter-domain signaling must be scalable, existing approaches not flexible enough:
  - only aggregation towards destination (sink-based trees, rare case)
  - aggregates from edge-network to edge-network only
- Aggregation on Autonomous System (AS) level
  - aggregation of services due to flexibility of using different DiffServ mechanisms
  - BGP table can be used to find common paths
- Flexibility:
  - Full hierarchical aggregation concept
  - Autonomous decision of each DSDM when and where to aggregate
The DARIS principle

Dynamic Aggregation of Reservations for Internet Services

- Fundamental design goal: Scalability
- Aggregation at Autonomous System level

Dynamic Aggregation

- Middle AS: reduction to single state
- Reservation in advance for future requests
Dynamic Aggregates

- Aggregate creation – different cases

- Different nestings

- Inter-domain re-routing may cause conflicts

Signaling Support

- Reduce signaling overhead for aggregate management, e.g., incrementing aggregate capacity for inclusion of new reservation

- Domain Manager Signaling Protocol
  - Allows parallel signaling transactions
  - New approach: Forwarding and Response Waiting Conditions for synchronization

- Result: reduced setup latency, e.g., save more than one round-trip time for a simple aggregate increment

Varied Parameters:
- Total # of reservations issued by an end system and reservation request rate
- Reservation threshold (number of existing reservations before an aggregate is created)
- For each combination 100 runs with different random seeds

Reduction of Transit States

The graph shows the total number of transit reservation states for different DSDMs (Distributed System Design Model) with and without DARIS (Distributed Availability and Resilience Improvement System). The graph indicates a significant reduction in the number of transit states when DARIS is used, which can be critical for system performance and efficiency.
Transit States in DSDM 5

Transit States DSDM 7

Total # of Reservations per End System
Different Aggregation Policies

![Graph showing the total number of transit states (DSDM) versus the total number of reservations per end system for different aggregation policies.](image1)

Total # of Transits States (DSDM)

<table>
<thead>
<tr>
<th>Aggregation</th>
<th>Reservations</th>
</tr>
</thead>
<tbody>
<tr>
<td>not aggregated, minrsv 2</td>
<td>not aggregated, minrsv 8</td>
</tr>
<tr>
<td>aggregated, minrsv 2</td>
<td>aggregated, minrsv 8</td>
</tr>
<tr>
<td>not aggregated, minrsv 4</td>
<td>not aggregated, minrsv 100</td>
</tr>
<tr>
<td>aggregated, minrsv 4</td>
<td>aggregated, minrsv 100</td>
</tr>
</tbody>
</table>

"Real" Internet Topology of 08/1999 (5500 ASs)

![Graph showing the number of transit single reservations for different aggregation policies.](image2)

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Conclusion and Outlook on Future Work

- Problem: Global (Inter-Domain) scalability of end-to-end QoS Management (control plane)
  - Solved by applying Dynamic Aggregation of Reservations for Internet Services
    - Full hierarchical aggregation at AS level
    - Autonomous decisions of ASs when and where to aggregate
  - Special signaling support reduces reservation setup delay

- Further simulations with current Internet topologies (requires 64-bit platform)
- Enhanced implementation with support for mobile nodes