Dynamic Aggregation of Reservations for Internet Services

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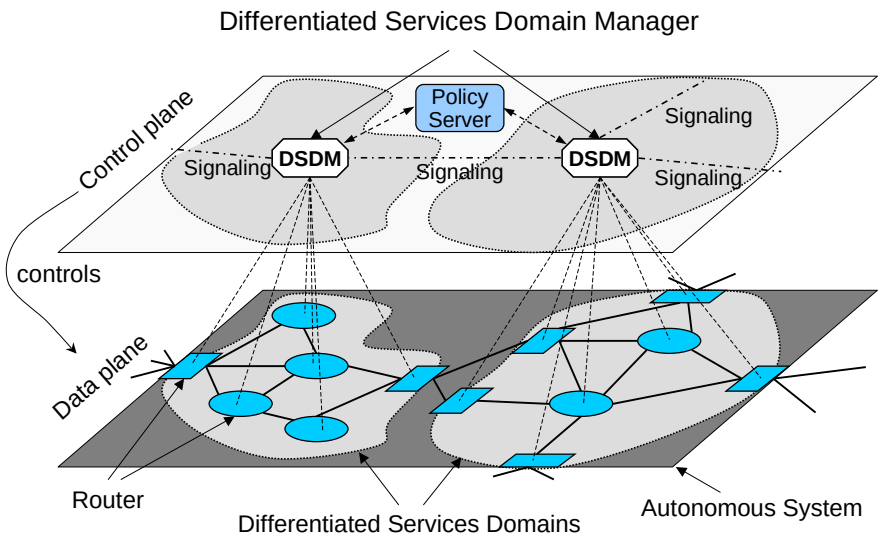
- Management Architecture DARIS
- Dynamic Aggregation
- Dedicated Signaling Support
- Simulation Results
- Conclusion and Outlook

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

Management Architecture – AR–S



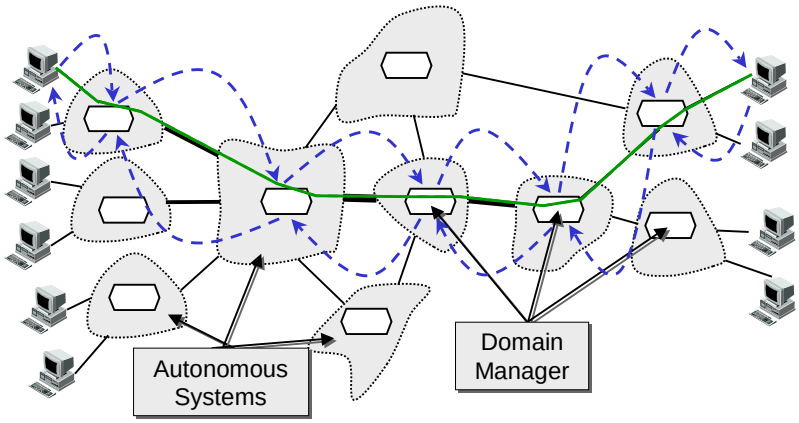
Inter-Domain QoS Signaling

- 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

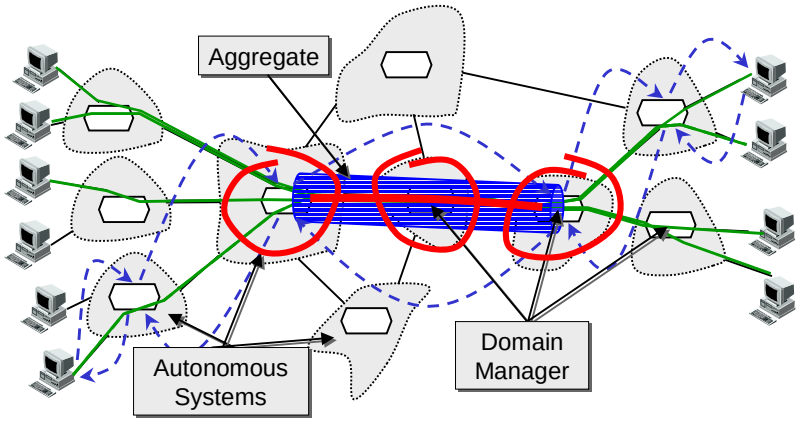
Dynamic **A**ggregation of **R**eservations for **I**nternet **S**ervices

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



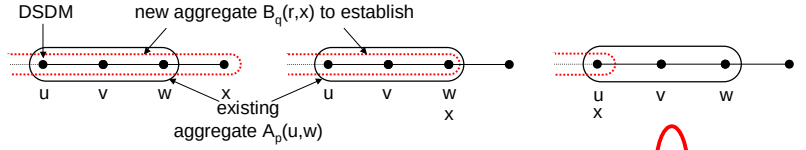
Dynamic Aggregation

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

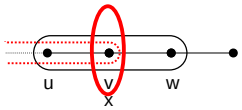


Dynamic Aggregates

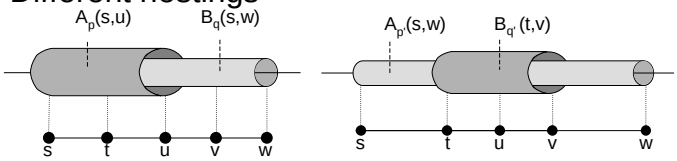
- Aggregate creation – different cases



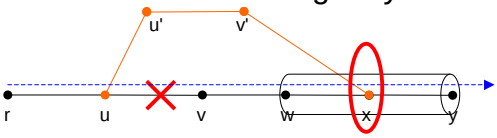
Conflict case



- Different nestings

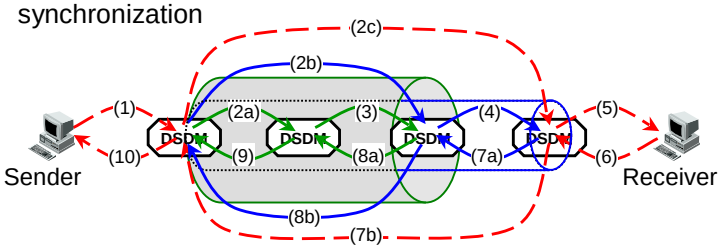


- Inter-domain re-routing may cause conflicts



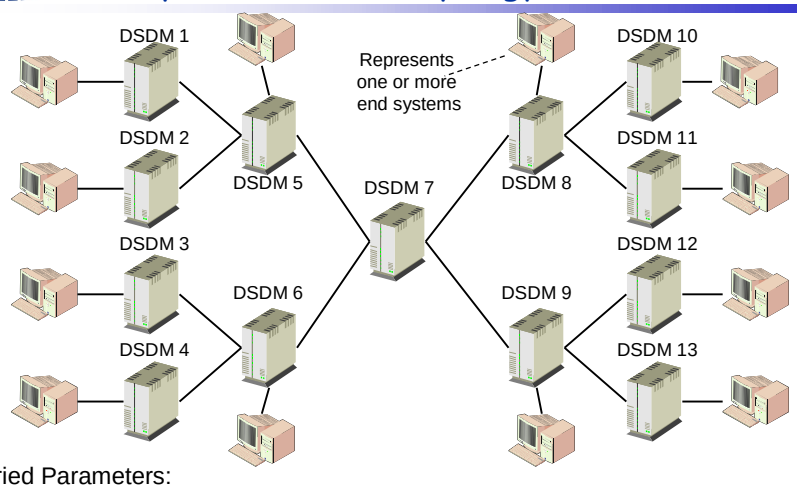
Signaling Support

- Reduce signaling overhead for aggregate management, e.g., incrementing aggregate capacity for inclusion of new reservation
- **D**omain **M**anager **S**ignaling **P**rotocol
  - 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

Simple Simulation Topology



Varied Parameters:

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

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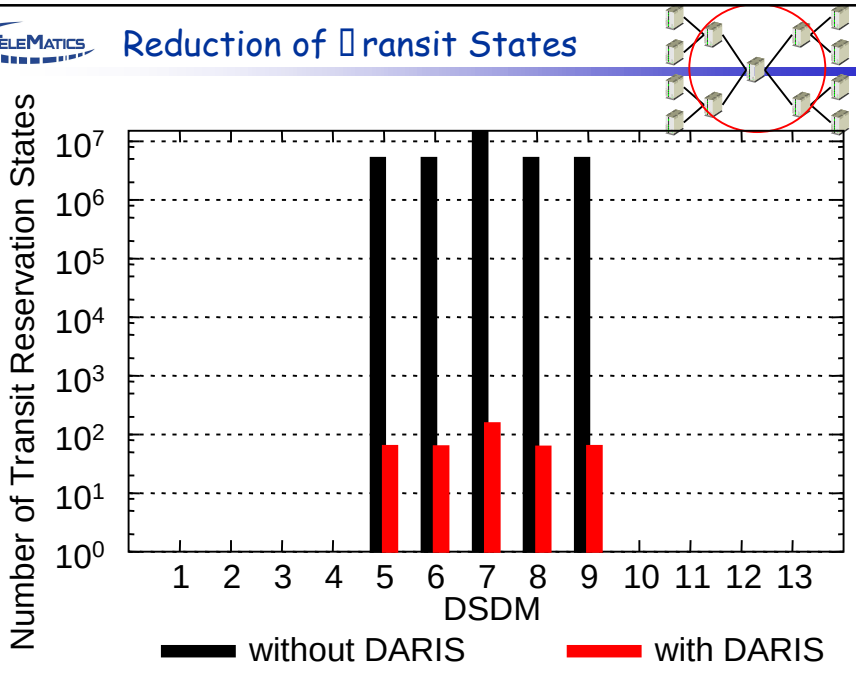
Reduction of Transit States



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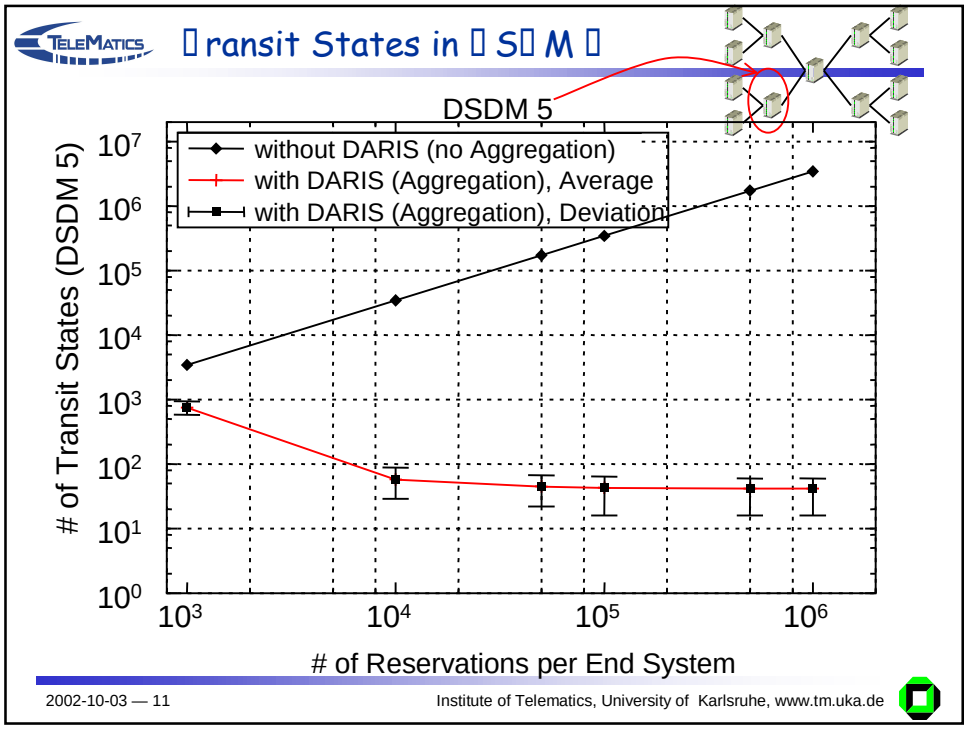
Transit States in DSDM
DSDM 5
without DARIS (no Aggregation)
with DARIS (Aggregation), Average
with DARIS (Aggregation), Deviation
# of Transit States (DSDM 5)
# of Reservations per End System
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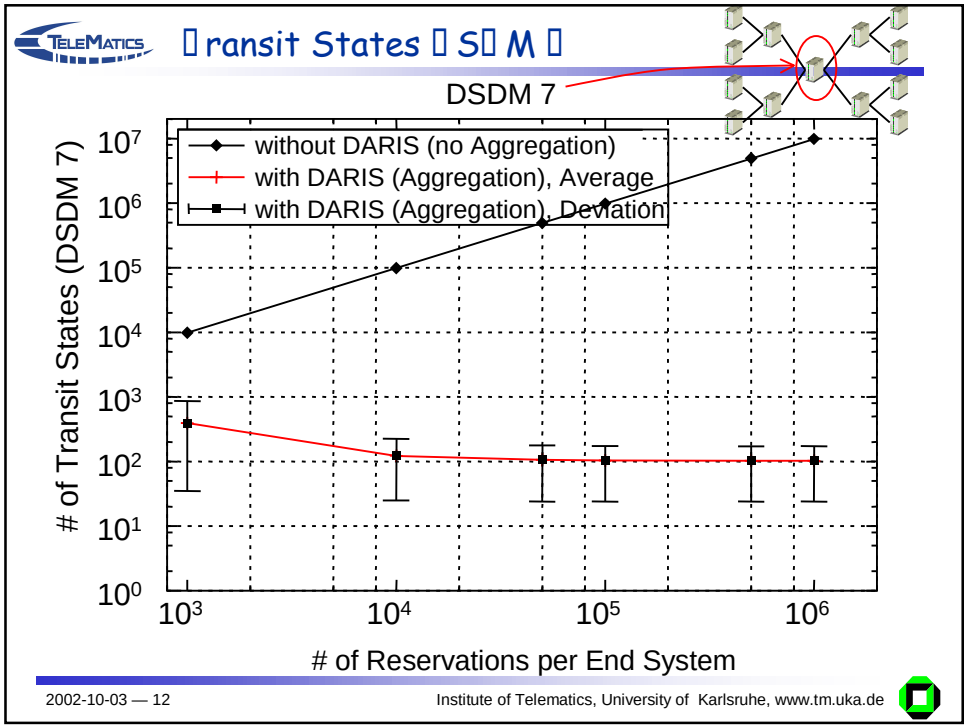
Transit States DSDM
DSDM 7
without DARIS (no Aggregation)
with DARIS (Aggregation), Average
with DARIS (Aggregation), Deviation
# of Transit States (DSDM 7)
# of Reservations per End System
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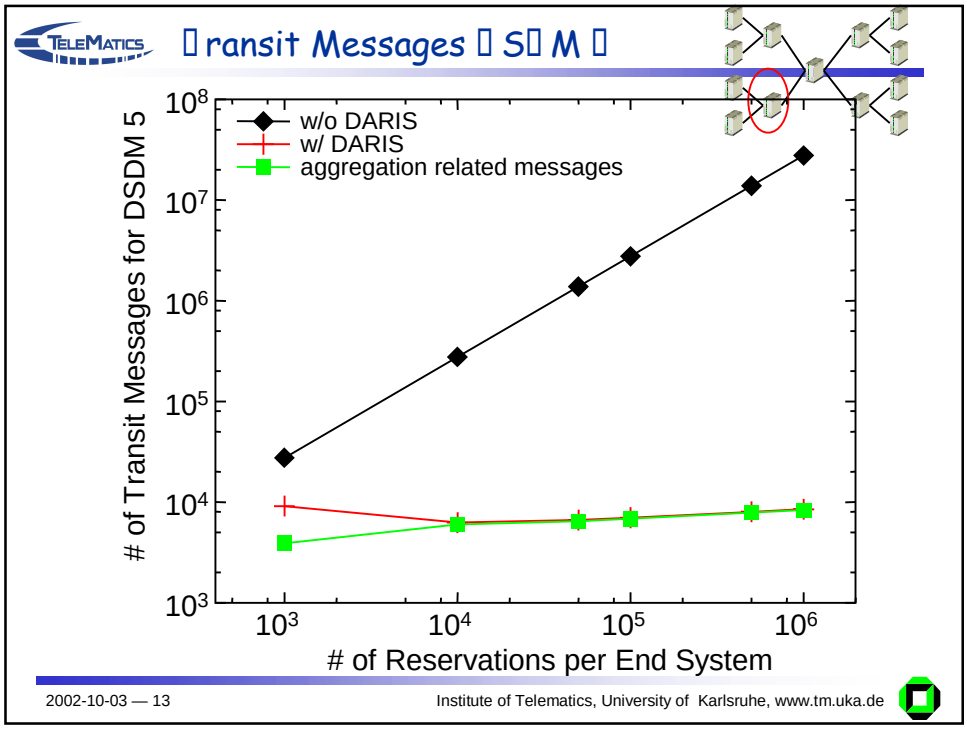
TELEMATICS
Transit Messages in SDM
w/o DARIS
w/ DARIS
aggregation related messages
# of Transit Messages for DSDM 5
# of Reservations per End System
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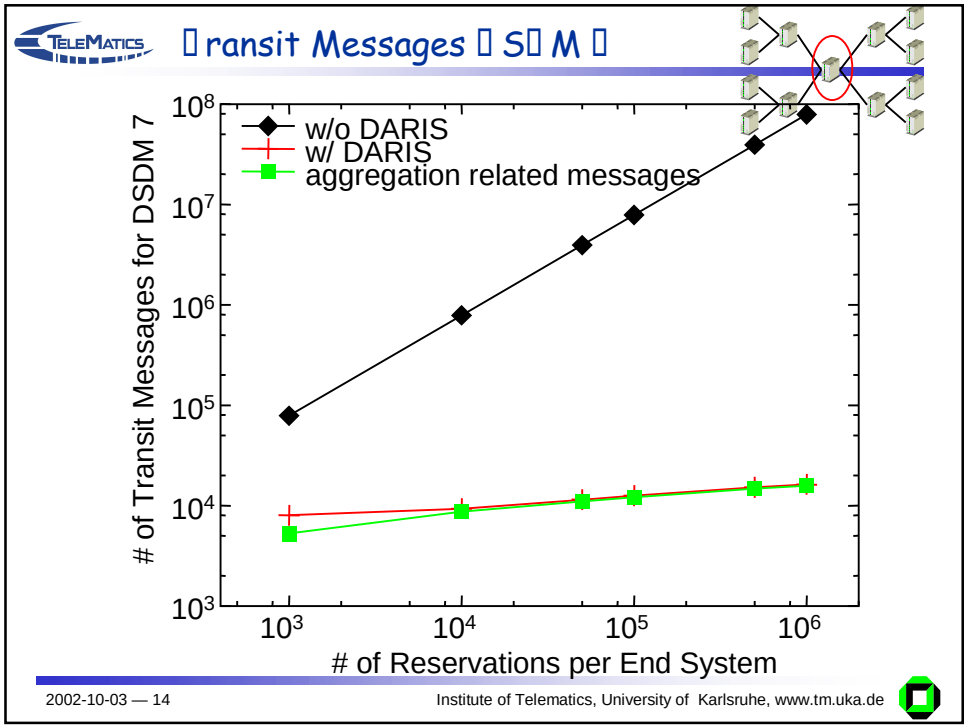
TELEMATICS
Transit Messages in SDM
w/o DARIS
w/ DARIS
aggregation related messages
# of Transit Messages for DSDM 7
# of Reservations per End System
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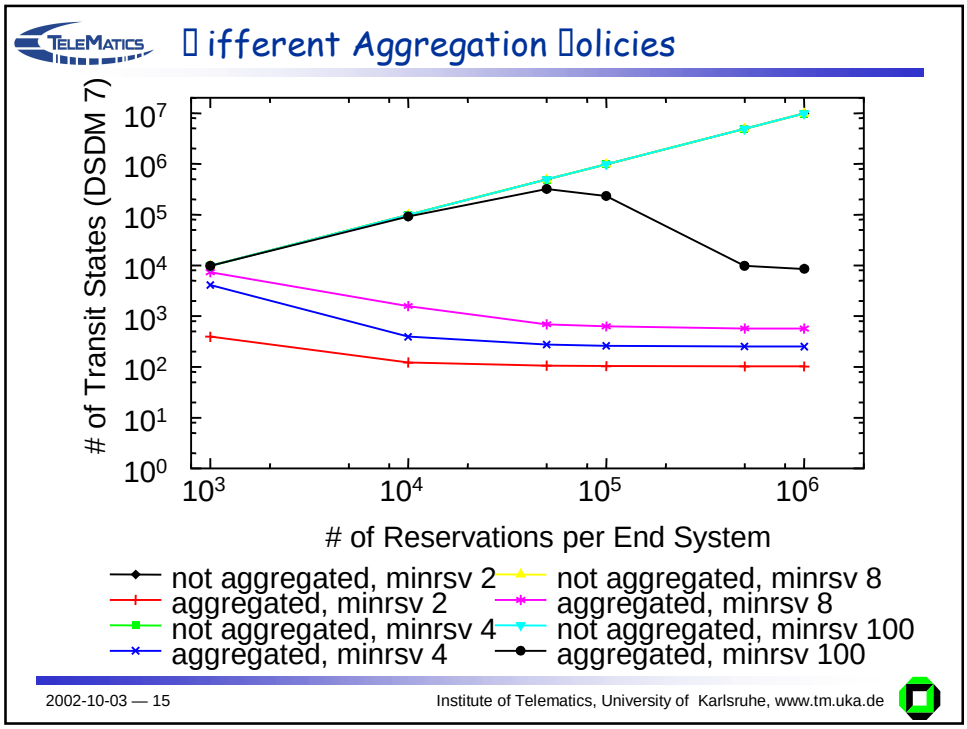
TELEMATICS
ifferent Aggregation olicies
# of Transit States (DSDM 7)
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^3
10^4
10^5
10^6
# of Reservations per End System
not aggregated, minrsv 2
aggregated, minrsv 2
not aggregated, minrsv 4
aggregated, minrsv 4
not aggregated, minrsv 8
aggregated, minrsv 8
not aggregated, minrsv 100
aggregated, minrsv 100
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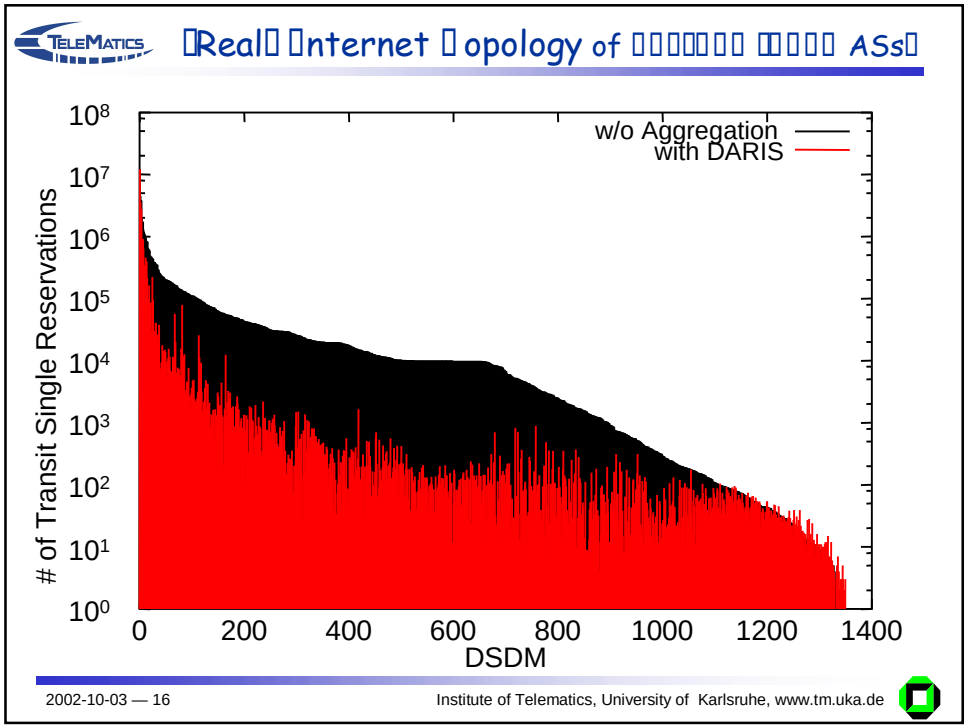
TELEMATICS
Real nternet opology of ASs
# of Transit Single Reservations
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
w/o Aggregation
with DARIS
0
200
400
600
800
1000
1200
1400
DSDM
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Conclusion and Outlook on Future Work

- Problem: Global (Inter-Domain) scalability of end-to-end QoS Management (control plane)
- Solved by applying
  Dynamic **A**ggregation of **R**eservations for **I**nternet **S**ervices
  - 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