On Dynamic Parallelism Adjustment Mechanism for Data Transfer Protocol GridFTP

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1. State Goals and Define the System

- ✓ Goals
  - ✓ Quantitatively evaluate performance of DPAM
    - ✓ DPAM: Dynamic Parallelism Adjustment Mechanism
  - ✓ Show pros/cons of four DPAM operations modes (MI, MI+, AIMD, GSS)
  - ✓ Confirm feasibility of DPAM in realistic environment
- ✓ System Definition
  - ✓ SUT (System Under Test)
    - ✓ Grid computing environment including...
      - ✓ Underlying IP network (routers and links)
      - ✓ Grid middleware (GridFTP server and client)
      - ✓ End hosts
  - ✓ CUS (Component Under Study)
    - ✓ DPAM for GridFTP client with four operation modes

2. List Services and Outcomes

- ✓ Services Provided
  - ✓ Reliable data transfer between GridFTP server and client
- ✓ Outcomes
  - ✓ High link bandwidth utilization?
  - ✓ Low packet loss probability?
  - ✓ Low packet transfer delay?

3. Select Metrics

- ✓ Speed (case of successful service case)
  - ✓ Individual
    - ✓ Goodput, latency, packet loss probability
  - ✓ Global
    - ✓ Queue occupancy, link utilization, packet loss probability
- ✓ Reliability (case of error)
  - ✓ None
- ✓ Availability (case of unavailability)
  - ✓ None

4. List Parameters

- ✓ System parameters
  - ✓ Network related
    - ✓ Topology
    - ✓ Link bandwidth, latency, loss ratio
    - ✓ Queue size, queue discipline
  - ✓ Host related
    - ✓ TCP socket buffer size
    - ✓ MTU, TCP version
  - ✓ DPAM related
    - ✓ Operation mode (MI, MI+, AIMD, GSS)
    - ✓ Control parameters: α, β, γ, η, N0, X, M
- ✓ Workload parameters
  - ✓ # of GridFTP sessions, request arrival rate, file size distribution
  - ✓ Background traffic pattern

5. Select Factors to Study

- ✓ System parameters
  - ✓ Network related
    - ✓ Topology
    - ✓ Link bandwidth, latency, loss ratio
    - ✓ Queue size, queue discipline
  - ✓ Host related
    - ✓ TCP socket buffer size
    - ✓ MTU, TCP version
  - ✓ DPAM related
    - ✓ Operation mode (MI, MI+, AIMD, GSS)
    - ✓ Control parameters: α, β, γ, η, N0, X, M
- ✓ Workload parameters
  - ✓ # of GridFTP sessions, request arrival rate, file size distribution
  - ✓ Background traffic pattern

6. Select Evaluation Technique

- ✓ Use analytical modeling?
  - ✓ No
- ✓ Use simulation?
  - ✓ Yes
- ✓ Use measurement of real system?
  - ✓ No

7. Select Workload

- ✓ GridFTP
  - ✓ # of GridFTP sessions: 1 - 100
  - ✓ Request arrival rate: 0 - 100% of utilization
  - ✓ File size distribution: random with avg. of 100MB – 1TB
- ✓ Background traffic
  - ✓ 0 -- 70% of the bottleneck link bandwidth

8. Design Experiments

- ✓ First Phase (many factors & few levels)
  - ✓ System parameters
    - ✓ Network related
      - ✓ Topology (Butterfly)
      - ✓ Link bandwidth (100M, 1Gbps), latency (10, 100ms), loss ratio
      - ✓ Queue size (100, 1000packet), queue discipline (DropTail/RED)
    - ✓ Host related
      - ✓ TCP socket buffer size (64K,1MB)
      - ✓ MTU, TCP version
    - ✓ DPAM related
      - ✓ Operation mode (MI, MI+, AIMD, GSS)
      - ✓ Control parameters: α (.5, 1, 2), β (.25, .5, .75), γ (1.5, 2, 3), η (.7, .8, .9), N0(1, 2, 4), X(10, 100, 1000MB), M (1, 4, 8)
  - ✓ Workload parameters
    - ✓ # of GridFTP sessions (1, 10, 100), request arrival rate (50, 75%), file size distribution (100M, 10GB)
    - ✓ Background traffic pattern (0%)
- ✓ Second Phase (few factors & many levels)
  - ✓ not yet

9. Analyze and Interpret Data

- ✓ Quantitatively evaluate performance of DPAM
  - ✓ When does DPAM work well/poorly?
  - ✓ How does DPAM work well/poorly?
  - ✓ Why does DPAM work well/poorly?
- ✓ Show pros/cons of four DPAM operation modes
  - ✓ What are pros of each DPAM operation mode?
  - ✓ What are cons of each DPAM operation mode?
  - ✓ Which operation mode is most/least effective?
- ✓ Confirm feasibility of DPAM in realistic environment
  - ✓ Is DPAM feasible in realistic environment?

10. Present Results

	link bandwidth	latency	queue size	queue discipline	TCP socket buffer size	operation mode	N0	X	M	# of GridFTP sessions	request arrival rate	file size distribution	background traffic pattern
goodput	↗	↘	→	↘	↗								
latency													
packet loss probability (individual)													
queue occupancy													
link utilization													
packet loss probability (global)													