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Grid Benchmarking

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Communication Intensive Grid Benchmark DT
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Abstract

This document provides a specification of a communication intensive benchmark for measuring the performance of grids when delivering large sets of data. The communication intensive grid benchmark Data Traffic (DT) works with distributed data sets and exercises various communication patterns on a grid. It measures the grid throughput and detects bottlenecks and slow communication links. The previously proposed communication intensive grid benchmarks GRASP [4] measured the grid's capacity to handle gather/scatter operations and communications along cycles.

Contents

1 Data Traffic Benchmark Specification

The Data Traffic (DT) benchmark captures core functionality of distributed data acquisition and processing systems. It includes data generating nodes (data sources), data processing nodes, data consuming nodes (data sinks), communication graph, and two special nodes "Launch" and "Report" cf. [2, 3]. The arcs of the graph indicate the directions the data are communicated between the nodes. The "Launch" node initiates the data sources. The "Report" node combines the checksums obtained from the data sinks and generates the verification status of the benchmark. The data processing algorithm is chosen to fully utilize the processor's capability to stream data through. To minimize DT turnaround time it would be advantageous to assign the processing nodes to separate processors and to use a fast network to stream the data to/from the processing nodes. As a measure of the benchmark performance we use the throughput, see Section 1.6.

1.1 Data Sources

A data source generates a set of feature points confined by a three dimensional box. Each feature point is represented by three coordinates and the feature type. The structure of the data models the output of the feature extraction channel used to process images acquired by the satellites. All four numbers are uncorrelated pseudo random numbers. Each source uses its own seed and generator to generate a random number of feature points. The size of generated data will scale from a few KB (class S benchmark) to many MB (class C benchmark), see Section 1.5.

1.2 Processing Nodes

A processing node receives one set of feature points per each incoming arc. It performs a sliding window filter operation on all input sets and generates a single output set. The node sends the resulting set along all outgoing arcs.

1.3 Data Sinks

A data sink receives one set of feature points per each incoming arc. It performs a sliding window filter operation on all input sets and generates a single checksum number. Then the node sends the checksum to the report node.

1.4 Communication Graphs

The communications in DT are defined by a communication graph and by an assignment of the benchmark nodes to the vertices of the graph. The smallest communication graphs (class S) are shown in Figure 1.

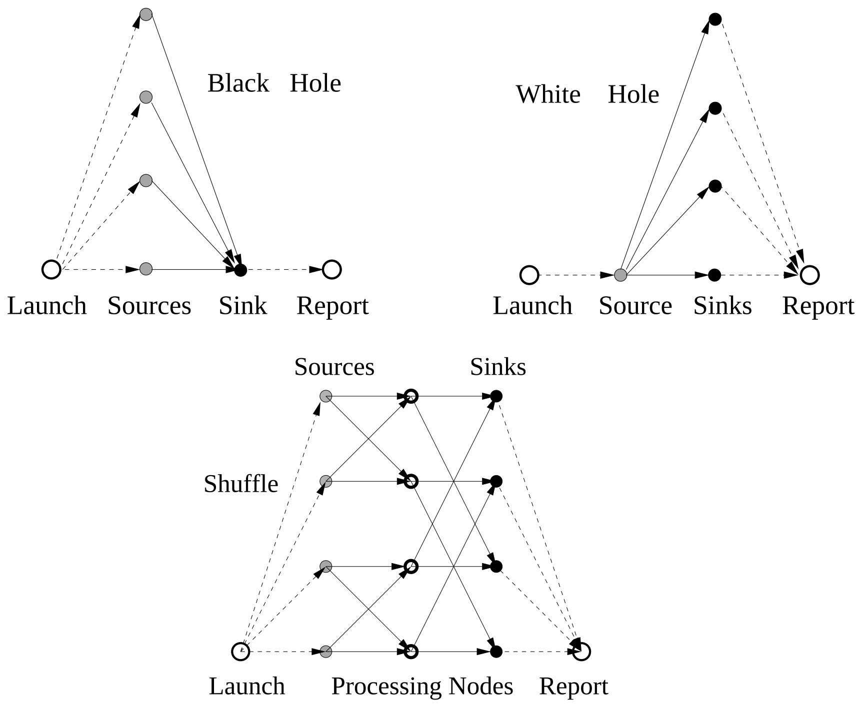

Figure 1: **DT communication graphs.** DT-BH collects data from multiple sources in a single sink, DT-WH distributes data from a source node to multiple sinks, DT-SH shuffles data and sends them to the sinks. The sources are shown as grey circles, processing nodes are shown as rings, and sinks are shown as black circles. The dashed arcs indicate control flow between nodes and the solid arcs indicate data and control flow.

1.5 Benchmark Scaling

The DT benchmark (in-line with tradition of NPB [1] and NGB [2]) will have classes S, W, A, B, and C of increasing volume of data and the graph complexity. It will scale up the volume of data generated by sources and processed by the processing and sink nodes. The scaling factor will be chosen to reflect speed of growth of the amount of data sent over the internet. DT also will scale up the number of nodes and arcs in the graphs. The graph scaling factor will be chosen to reflect growth the number of processor in the computational grids.

1.6 Metrics

As a measure of the benchmark performance we use the throughput defined as a ratio of the total volume of transmitted data to the benchmark turnaround time.

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3 Intellectual Property Statement

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