Benchmarking Apache Arrow Flight
A wire-speed protocol for data transfer, querying and microservices

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Overview

• Apache Arrow
• Arrow Flight

• Data Transfer Benchmarks
• Use Cases
  • Transactional databases and columnar store
  • Query Subsystems
  • Microservices Integration

• Future Outlook
Apache Arrow

- Language-agnostic in-memory columnar data structures
- Random access
- Maximum throughput
  - Vectorized processing/SIMD
  - Pipelining
  - cache locality
- GPU/FPGA
Arrow Flight

- High performance wire protocol for bulk Arrow data transfer
- Cross-platform
- Parallel
- Security
Arrow Flight

Flight Consumer (Client)

Get FlightInfo (FlightDescriptor)

Flight Service (Server)

FlightInfo

DoGet()

FlightData

C/C#/C++/Python/Java/Rust etc. Application
Arrow Flight
Arrow Flight
Arrow Flight
Data Transfer Benchmarks

- Localhost and client-server
- 16 physical cores (32 hyper-threading jobs)
- InfiniBand adapter 4 × FDR (56 Gbit/s inter-node bandwidth)
- 1, 2, 4, 8 and 16 streams in parallel
- Each stream having 10-90 million records
Data Transfer Benchmarks

- **Localhost**
- **1GB/s for single stream up to 10GB/s for 16 streams**
Data Transfer Benchmarks

- Remote client-server
- 6000 MB/s throughput for DoGet()
- 4800 MB/s throughput DoPut()
Data Transfer Benchmarks

• TCP performance on Infiniband
  • 1700 MB/s (1 stream) – 5300 MB/s (16 streams)
Data Transfer Benchmarks

- TCP (iPerf3) -> 5.4 GB/s
- RDMA (ib verbs) -> 6.2 GB/s (close to the theoretical max of 7 GB/s)
- Arrow Flight -> 5.9 GB/s (95% of the RDMA bandwidth or more than 80% of the maximum achievable bandwidth)
USE CASE-I

Transactional data analytics

• Comparing four different export methods,
  • Client-side RDMA
  • Arrow Flight RPC
  • Vectorized wire protocol
  • Row-based PostgreSQL wire protocol.

• Flight uses up to 80% of the available bandwidth

"Mainlining Databases: Supporting Fast Transactional Workloads on Universal Columnar Data File Formats" by Tianyu Li et al.
USE CASE-II

Query Subsystems

- a) Without Flight
- b) With Flight

"Don’t Hold My Data Hostage – A Case For Client Protocol Redesign" by Mark Raasveldt et al.
Query Subsystems

• Dremio – ODBC
• Dremio – turbodbc
• Dremio – Flight
• Data-Fusion – Flight
• Apache Arrow - FlightSQL
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Presentation by Tomer Shiran on "Data Science Across Data Sources with Apache Arrow"
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USE CASE-III
Microservices Integration

• Flight Data Microservice - Apache Spark
• Flight Data Microservice - Apache Spark/TensorFlow Clients
• XGBatch - Pandas/Dask
• FlightGrid/PyGrid - AI Models Training
• The Mesh for Data platform - Arrow/Flight module
• Magpie - A Pandas based unified data processing engine
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https://githubhot.com/repo/ehenry2/xgbatch
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Future Outlook

• Arrow Flight on RDMA
• FlightSQL
• Transactional and analytical workloads
Thanks!