

Satisfying Data-Intensive Queries Using GPU Clusters

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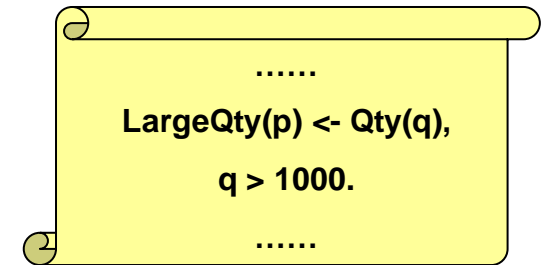
Sponsors: AIC, AMD, LogicBlox Inc., National Science Foundation, NEC, NVIDIA

Application: Data Warehousing



- On-line and off-line analysis

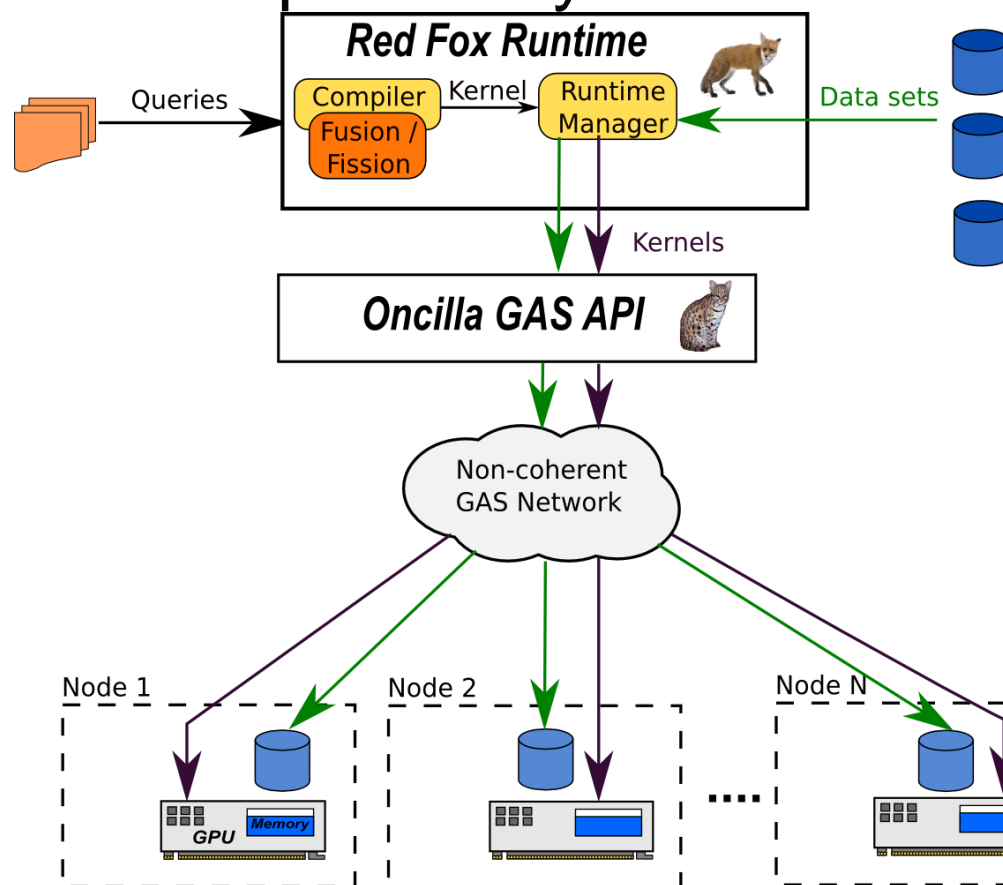
- Retail analysis
- Forecasting
- Pricing
- Etc...



- Combination of **relational data queries** and computational kernels
- Current applications process **1 to 50 TBs** of data [1]
- Techniques can be applied to other "Big Data" problems like irregular graphs, sorting

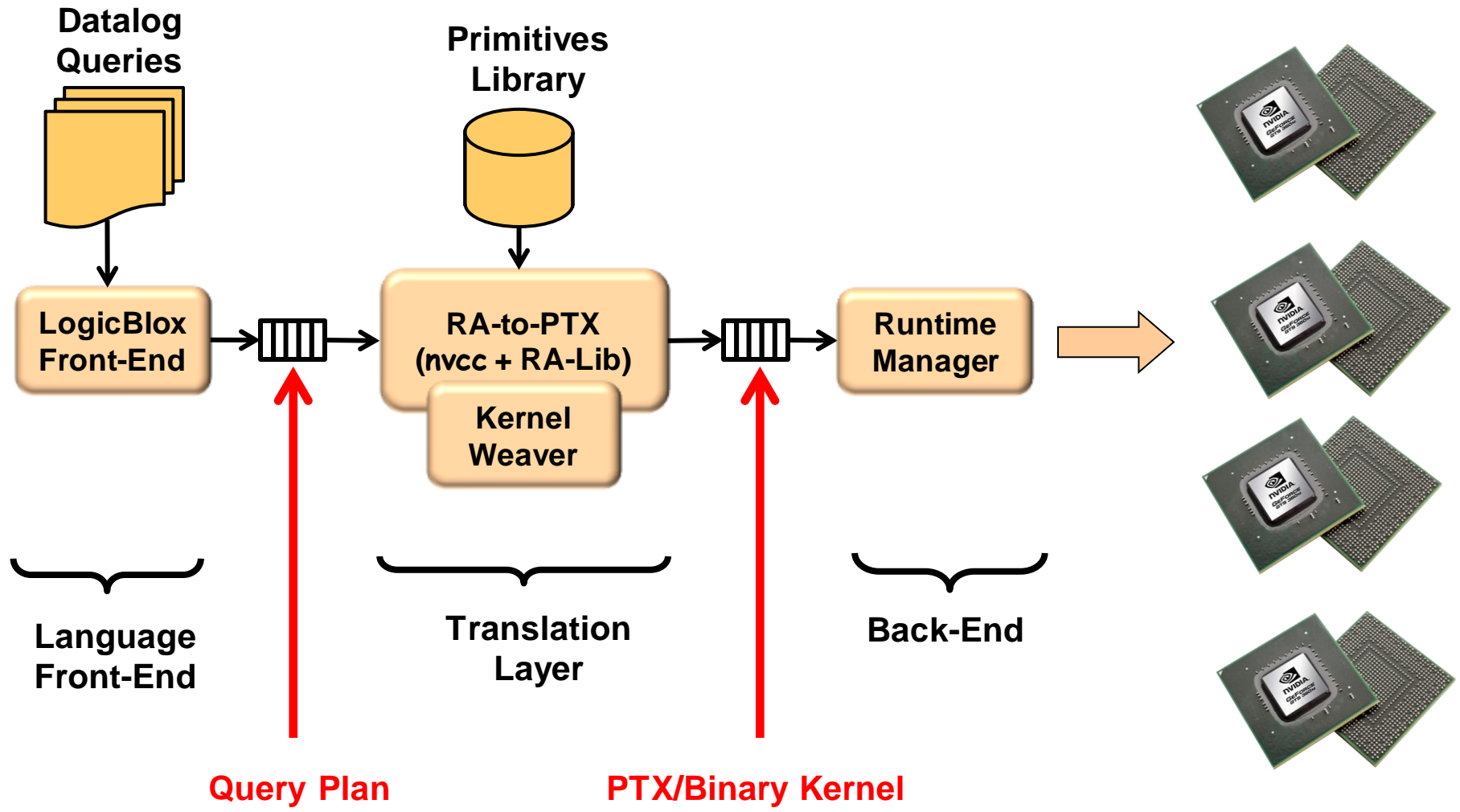
[1] Independent Oracle Users Group. A New Dimension to Data Warehousing: 2011 IOUG Data Warehousing Survey.

Proposed System Model



- **Red Fox**: Compilation and optimization of queries for GPUs
 - Remove need for application developer to optimize applications to run on GPUs
- **Oncilla**: Global Address Space (GAS) layer
 - Create an API to simplify data movement and scheduling

Red Fox Compilation Flow

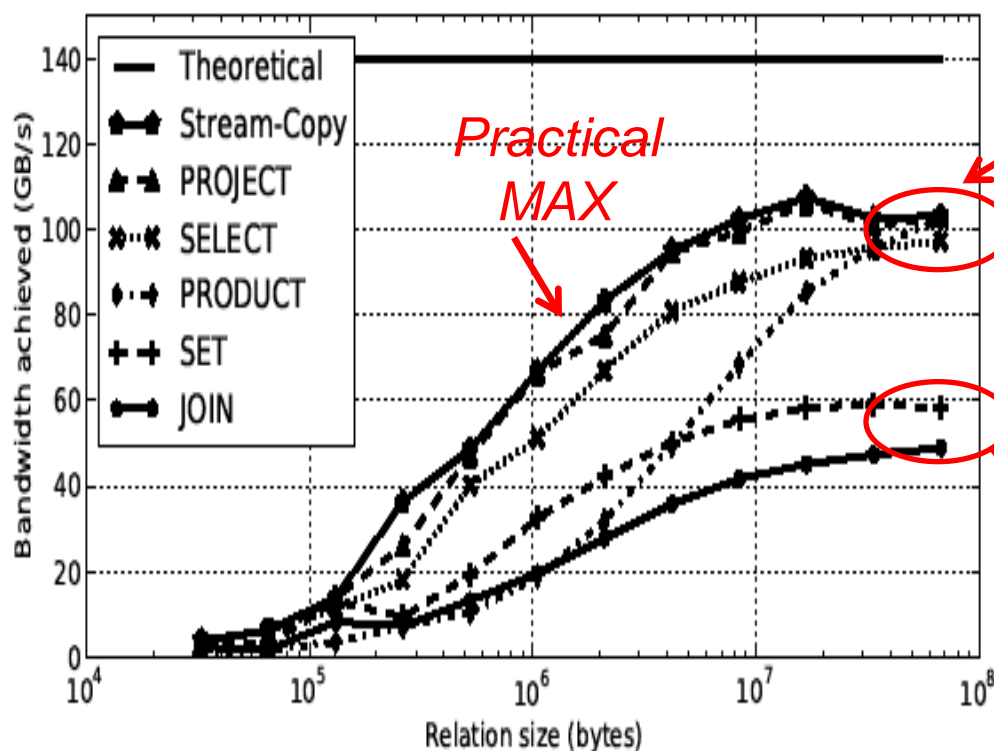


Relational Algebra Primitives on GPUs

Raw Performance (NVIDIA C2050)

Fastest known for GPUs!

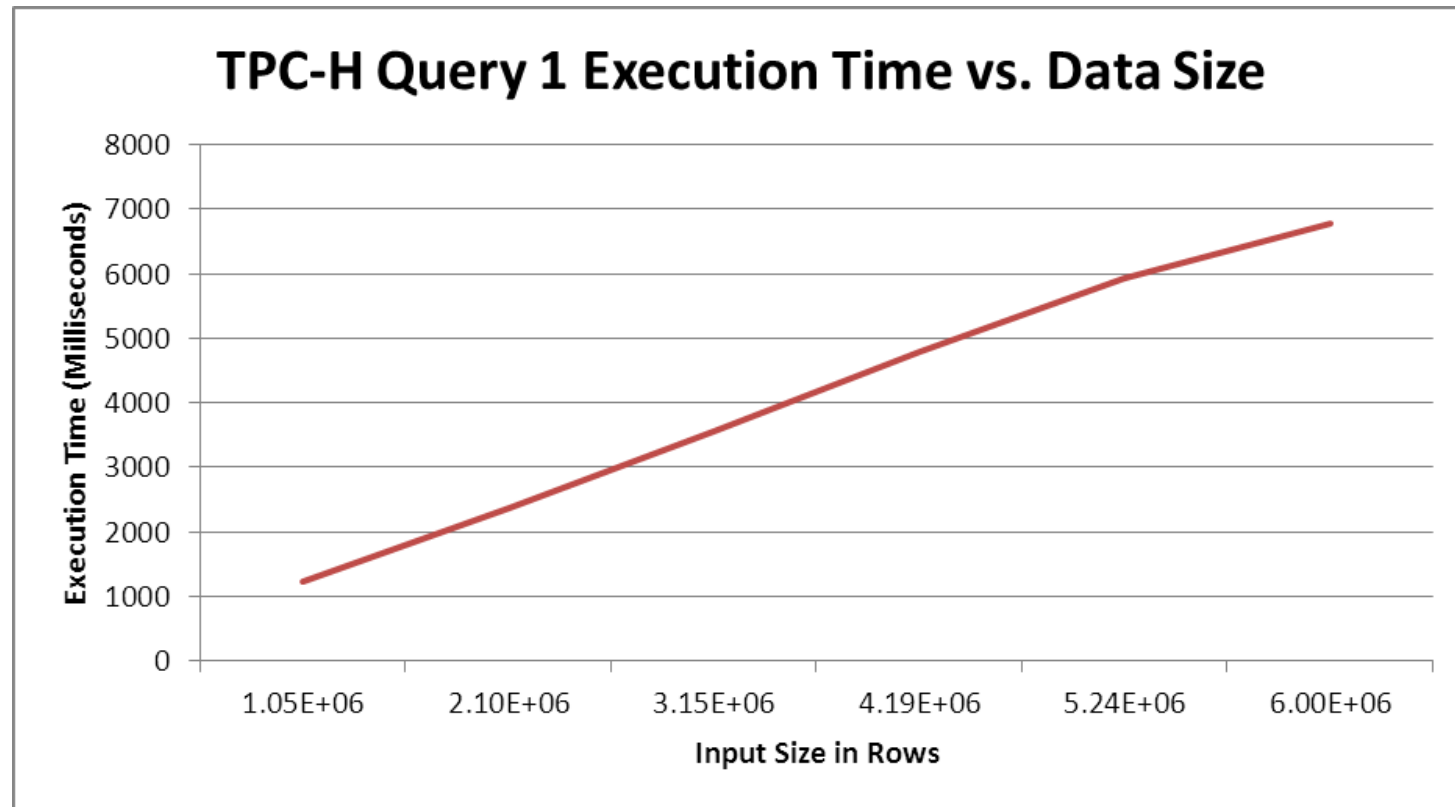
- Multi-stage algorithm



- Simple primitives are close to maximum performance

- More complex primitives could show better performance with newer implementations (in progress with NVIDIA Research)

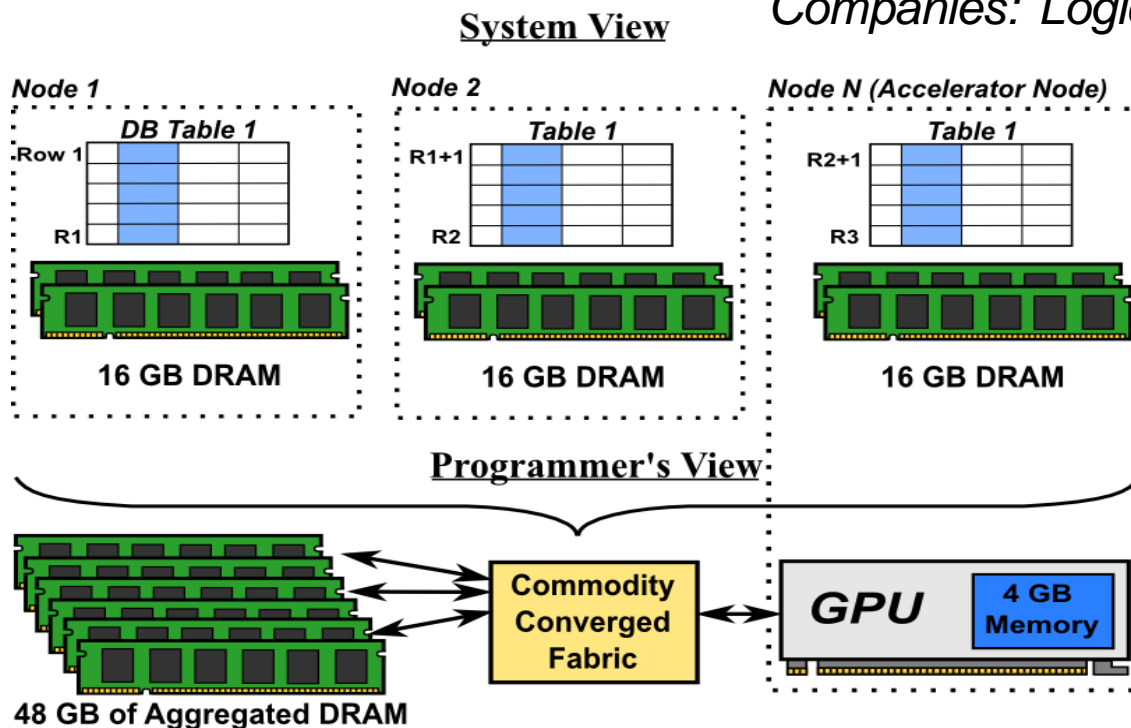
Red Fox: TPC-H Q1 Results



- GPU computation scales well with problem size
- Improved primitives could lead to further 10x speedup

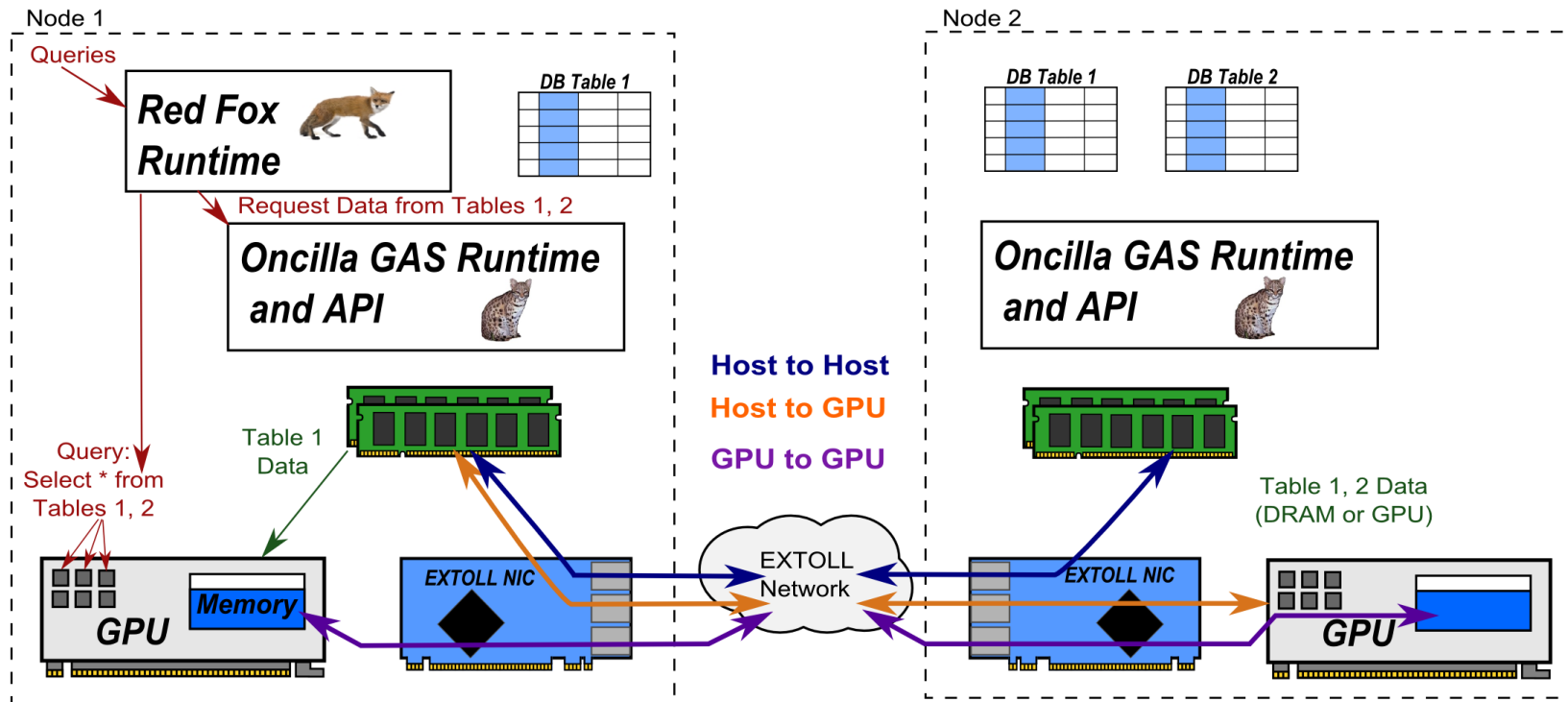
Oncilla: Fabrics for Accelerator Clouds

Companies: LogicBlox, NVIDIA, AIC



- **Goal:** Transparent, efficient host memory aggregation across node for accelerators
- **Solution:** Use Global Address Spaces (GAS) and commodity fabrics (HT, QPI, PCIe, 10GE, IB)
 - Support in-core databases using software from **Red Fox** project

Oncilla: Efficient Data Movement



- Oncilla aims to combine support for multiple types of data transfer and CUDA-based optimizations under a simplified runtime.
 - Ex: `"oncilla_malloc(2 GB, node2, gpumem)"`
- Enable application developers and schedulers to take advantage of high-performance GAS without needing to be experts in specialized hardware

Questions?

For more information:

Red Fox:

H. Wu, G. Damos, H. Cadambi, and S. Yalamanchili, "KernelWeaver: Automatically Fusing Database Primitives for Efficient GPU Computation," MICRO, December 2012

<http://gpuocelot.gatech.edu/projects/compiler-projects/>

Oncilla:

<http://gpuocelot.gatech.edu/projects/compiler-projects/oncilla-gas-infrastructure/>

J. Young, S. Yalamanchili, *Commodity Converged Fabrics for Global Address Spaces in Accelerator Clouds*, HPCC, June, 2012