

Tobias Lauer  
University of Freiburg  
Georges-Köhler-Allee 051  
79110 Freiburg, Germany  
lauer@informatik.uni-freiburg.de

Amitava Datta  
University of Western Australia  
35 Stirling Highway  
Perth, WA 6009, Australia  
datta@csse.uwa.edu.au

Zurab Khadikov  
Jedox AG  
Bismarckallee 7a  
79098 Freiburg, Germany  
zurab.khadikov@jedox.com

## Online Analytical Processing (OLAP)

OLAP is a core technology in *Business Intelligence* and *Corporate Performance Management*, allowing users to navigate and explore corporate data (usually extracted from a data warehouse) and to roll up or drill down along different hierarchical levels. Also, updates to the data must be supported for planning and forecasting.

Due to the highly interactive nature of OLAP analysis, query performance is a key issue.

## Multidimensional Aggregation

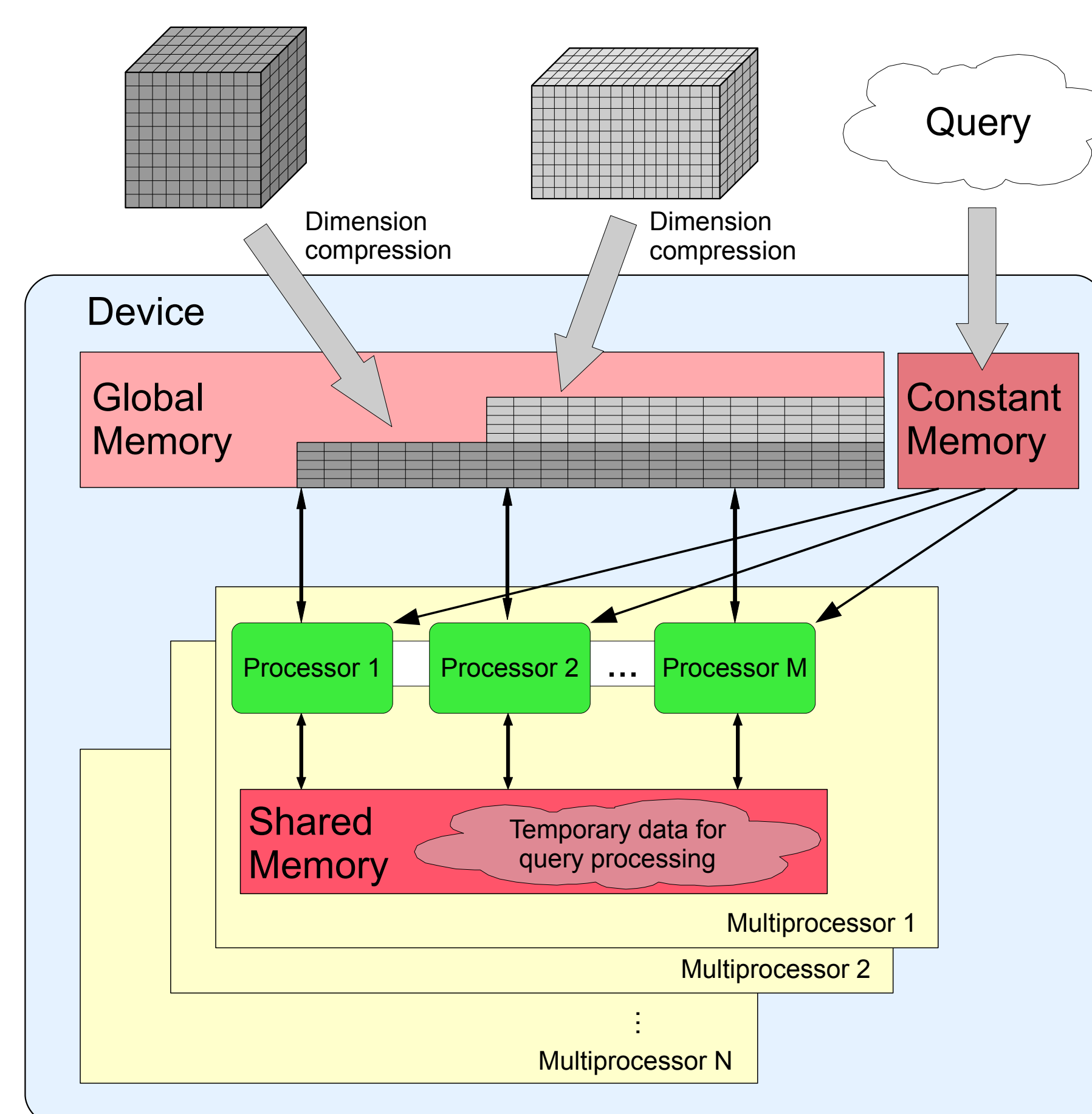
The conceptual model central to OLAP is the *Data Cube*, which is a view of the data as cells in a multidimensional table ("cube").

*Aggregation* along dimensional hierarchies is a basic building block involved in most OLAP operations. The main problems to solve in order to compute aggregates efficiently is the *sparsity* of data in high-dimensional spaces and the dimensional "explosion", since the number of possible aggregates grows exponentially.

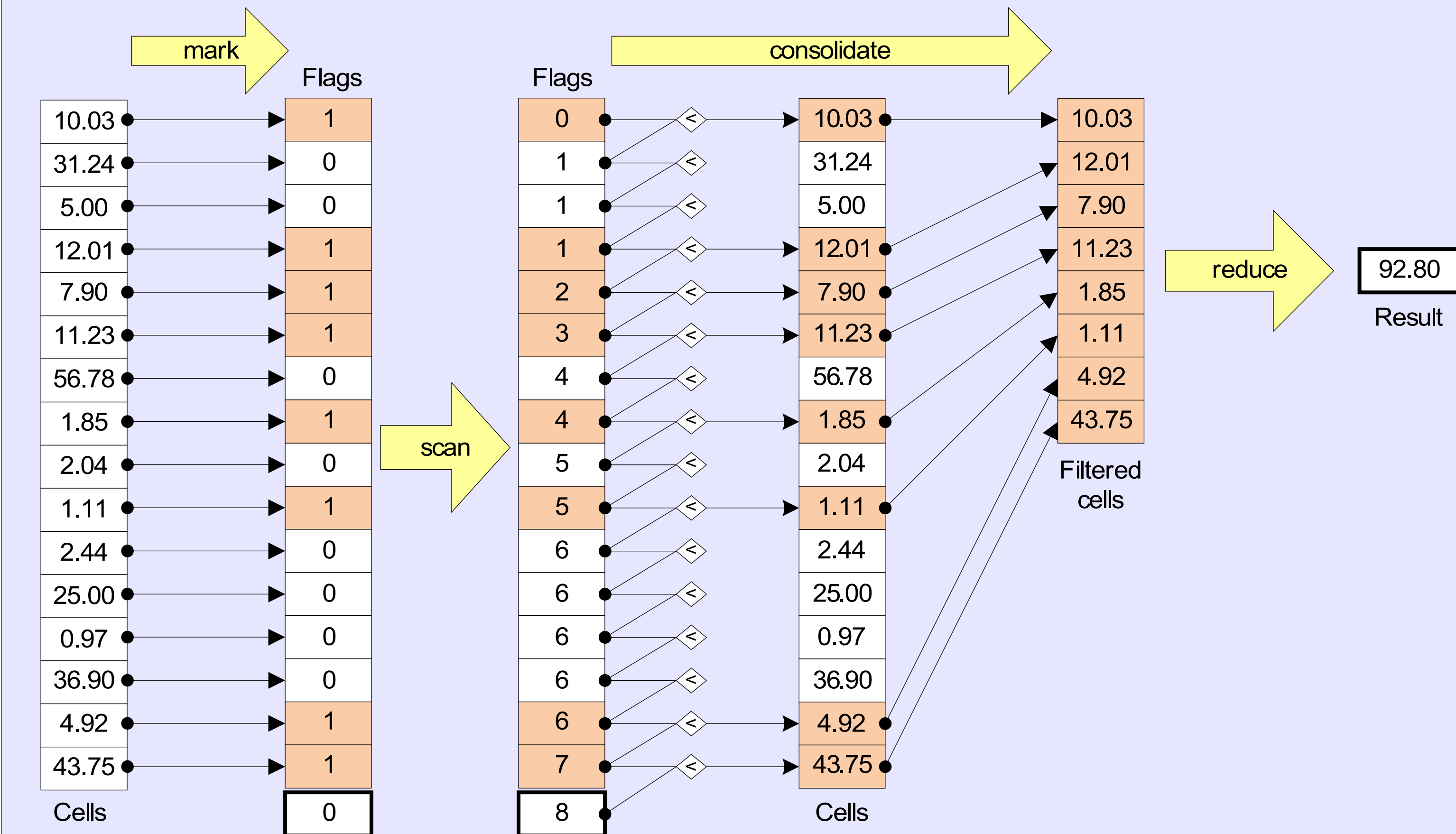
Our approach aims at speeding up aggregations by using the massively parallel architecture of GPUs.

## Data Storage on GPU

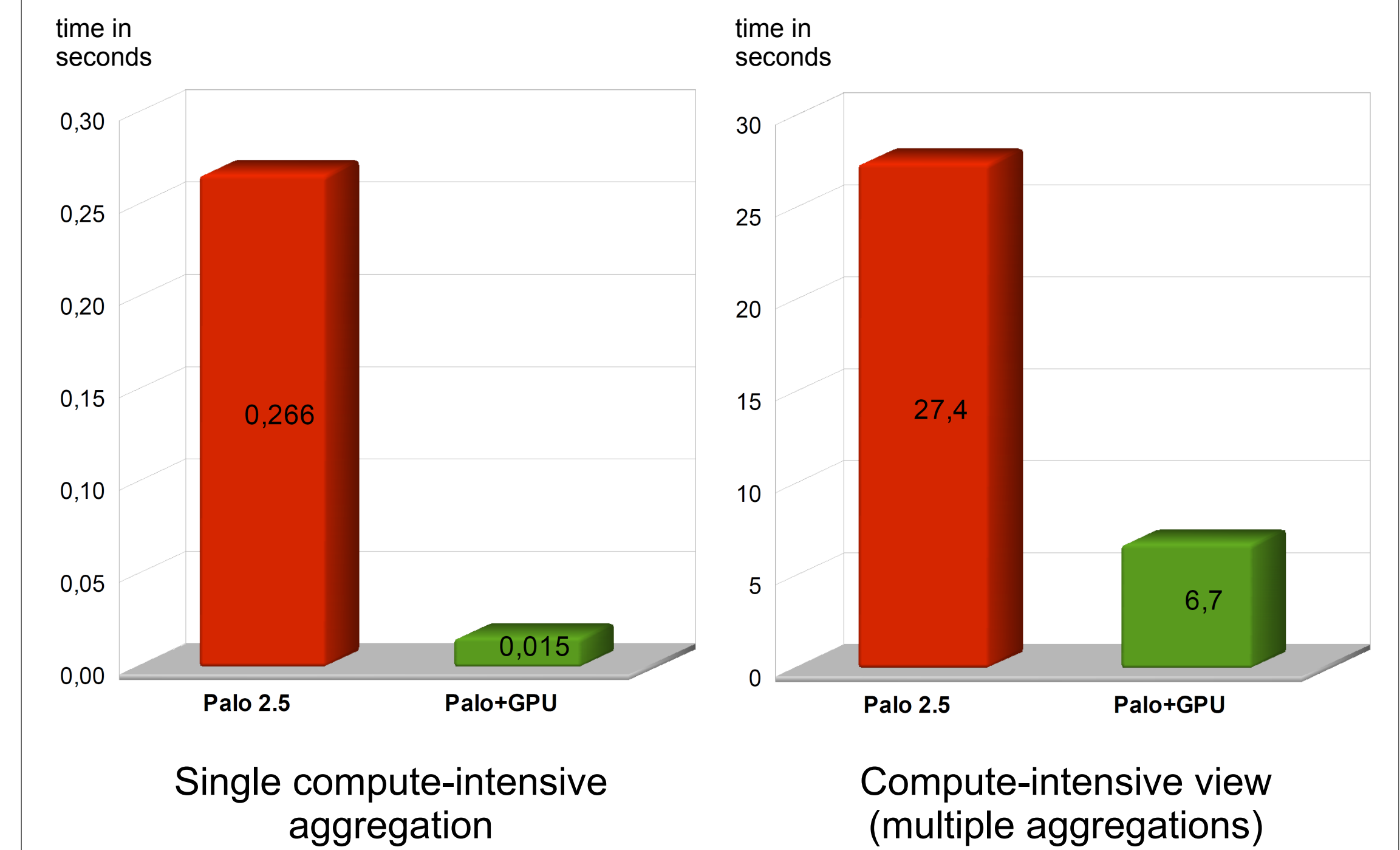
Usage of different GPU memory types for storage and processing of data cubes:



## GPU Aggregation Algorithm



## Performance Evaluation

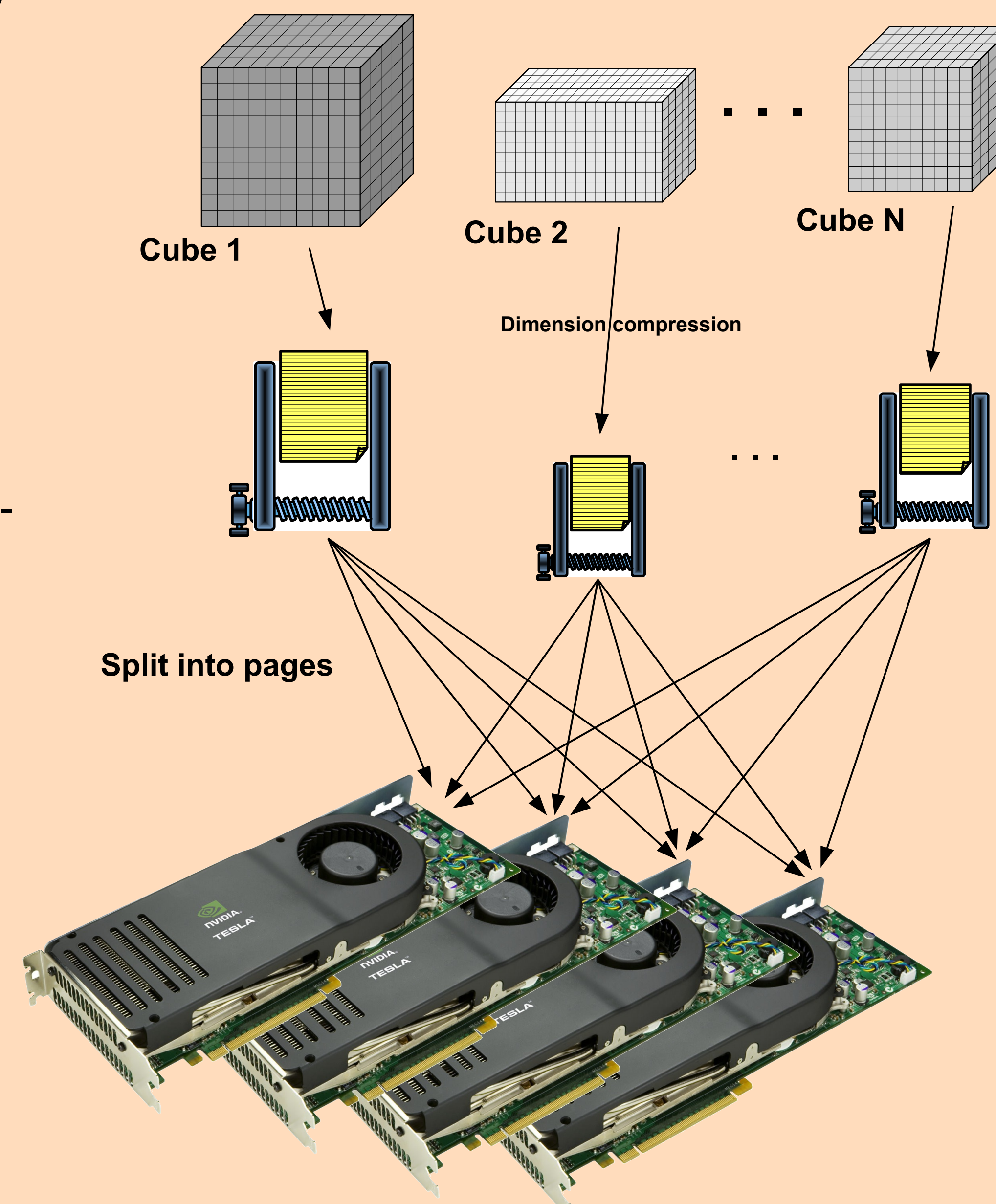


## Scalability

The proposed approach scales well to multiple GPUs.

All cube data are distributed among all available cards, ensuring that the workload is always divided evenly between the devices.

At the end, the individual results are aggregated by the main thread on the host.



## Current and future work

- Optimization of bulk queries
  - Two-stage algorithm
  - Pre-filtering
- Efficient updates to database
  - Spreading updated aggregate values to base facts
  - Allocation of new records in GPU memory
- Computation of advanced business rules
- Seamless integration of CUDA algorithms into Palo

## About Palo

Jedox AG, headquartered in Freiburg (Germany) with offices in Great Britain and France, is one of the leading suppliers of Open-source Business Intelligence and Corporate Performance Management solutions in Europe. Jedox' core product, *Palo BI Suite*, accommodates the entire range of BI requirements including planning, reporting and analysis.

The multidimensional *Palo OLAP Server* at the core of the *Palo BI Suite* integrates simply and easily existing MS-Excel solutions and optimizes planning, reporting and analysis.