



Toward **Open**

**Object-Based Computational Storage**

For **Analysis** **Query Pushdown**

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# 3 Things About Scientific Data

## Analytics

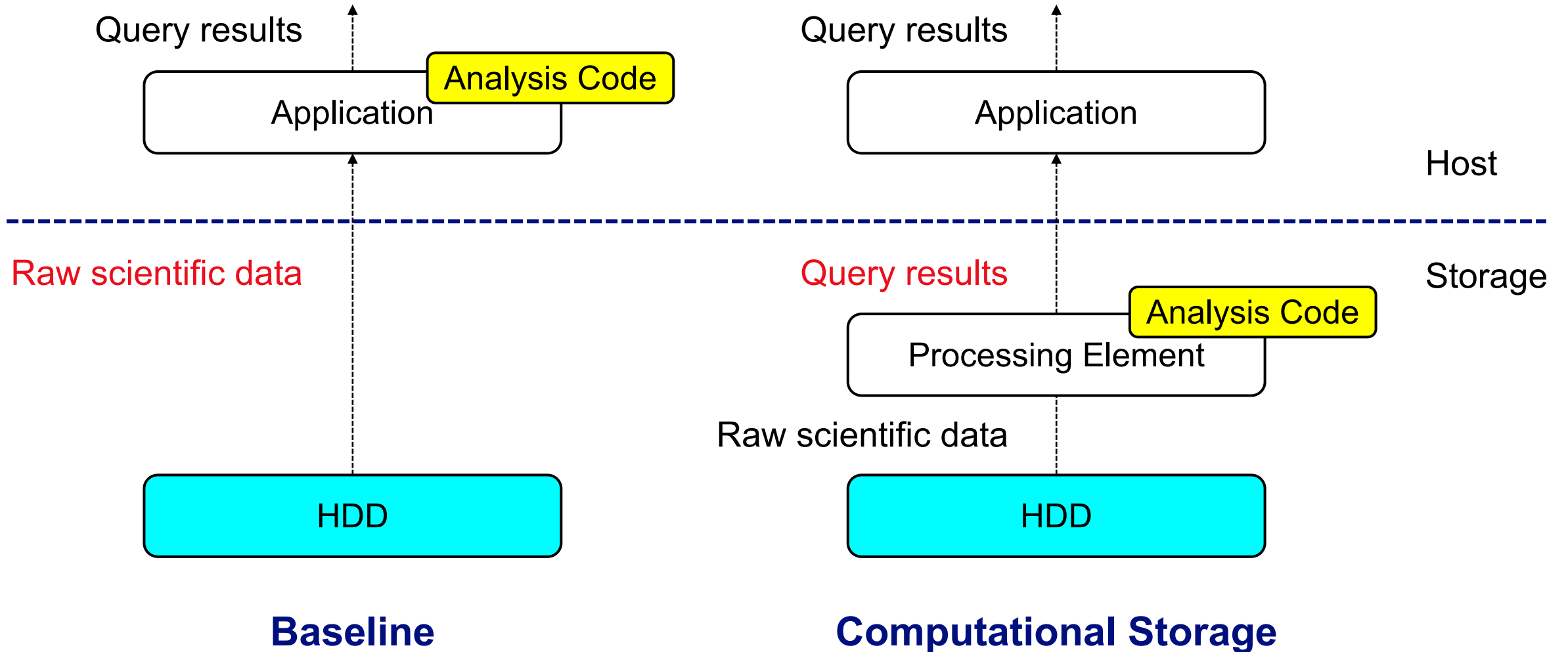
Data is big

Moving data is expensive

Queries often target a tiny portion of a large dataset



# Query Pushdown Through Computational Storage



# Data Agnostic vs Data Aware Offloads

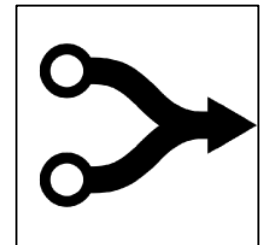
## Data Agnostic

- Storage does not know what's in the data (view data as byte streams)
  - Like what POSIX filesystems do today
- Example offloads: data compression, encryption, custom risc-v, eBPF functions

This effort will use the data aware approach

## Data Aware

- Storage and apps agree on a data format (e.g., Apache Parquet) and a query format (e.g., Substrait)



# Storage Interface: Block? KV? Object?

## Block

- Best for **data agnostic operations** (compression, encryption)

## KV

- Best for **row-based** applications such as various PIC (particle-in-cell) codes

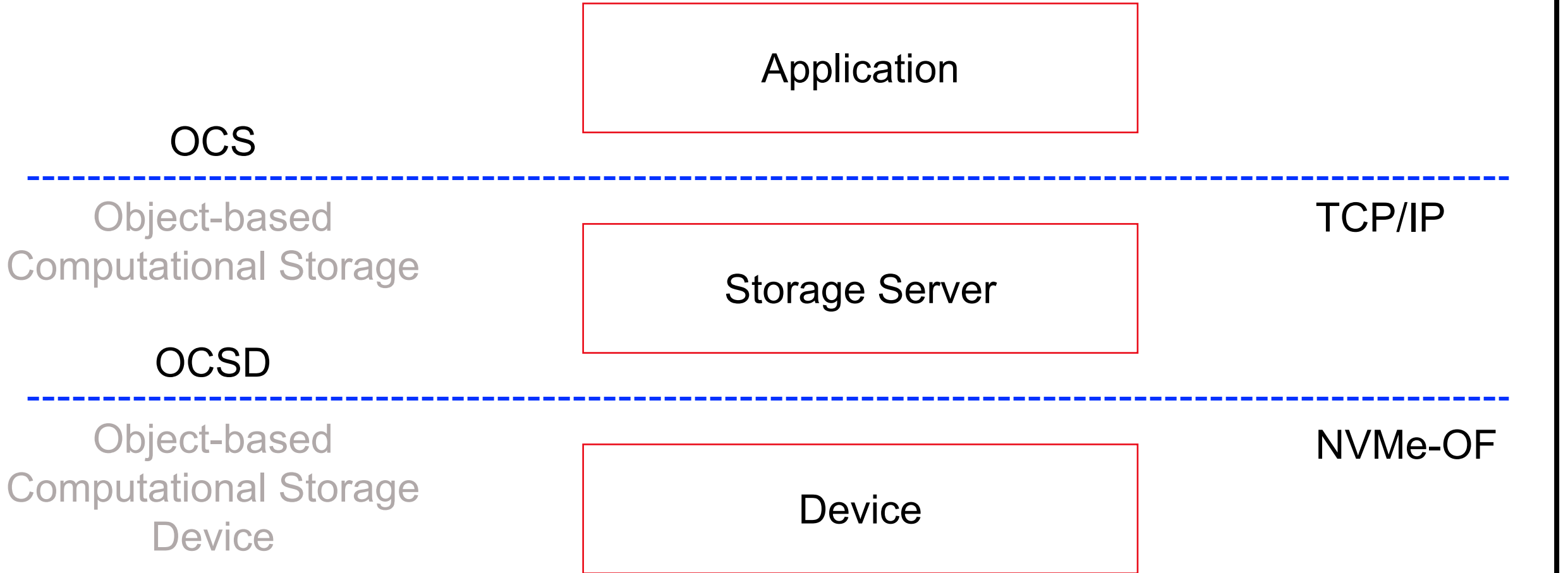
## Object (each can be a Parquet fragment)

- Enable **columnar** analytics often seen in grid-based codes in addition to PIC codes

Prior work at Los Alamos looked at these (ZIA, KV-CSD, C2) in collaboration with Aeon, Eideticom, Nvidia, SK hynix, Seagate

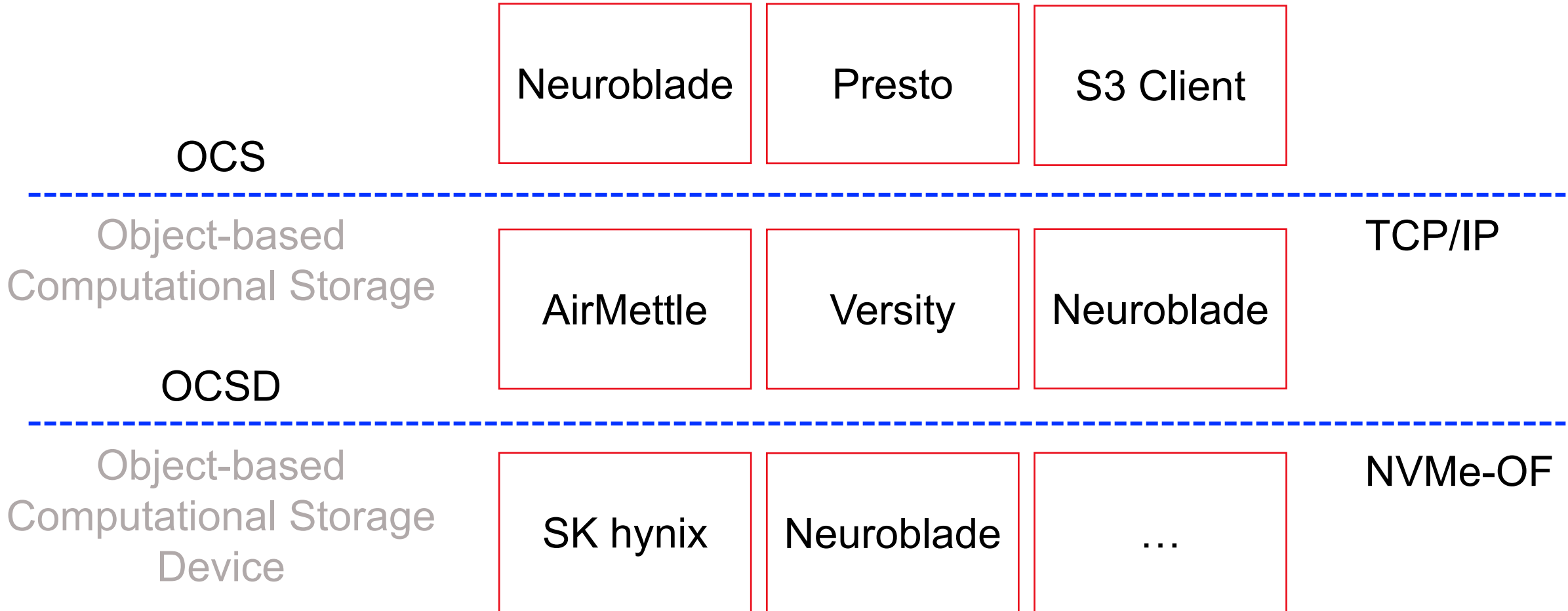
# Standardization

Query Pushdown



# Industry Ecosystem

Query Pushdown

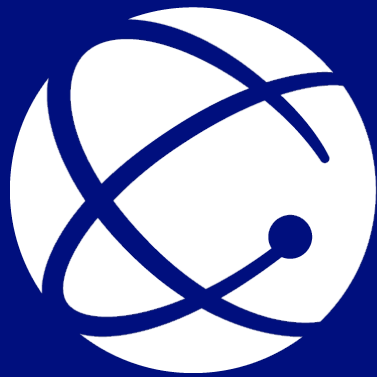


The background of the image is a dark, starry space scene. A large, solid black circle is positioned on the right side, partially overlapping a bright, glowing white ring that resembles a solar or lunar eclipse. The text is overlaid on this background in two purple boxes and one cyan box.

**LANL/SK hynix Demo**  
**at Exhibition Hall**

**Booth #2101**





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