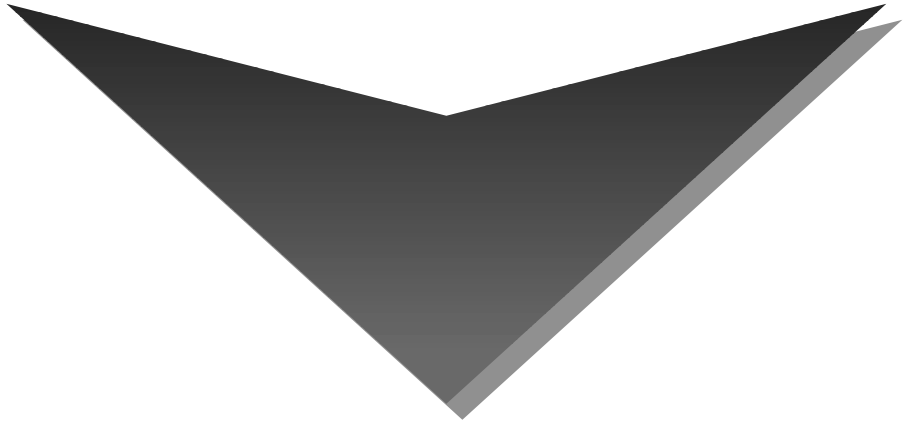

Informix Universal Server: A Parallel ORDBMS

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What It Is and Isn't

- a single extensible database engine that manages all your data
- full relational power and performance
- improved Illustra Functionalities re-implemented under DSA
- parallel everything!
- IS NOT
  - ➢ Illustra and Informix loosely bundled
  - ➢ source code merge

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Talk Outline

- IUS Architecture
- IUS Feature Overview
- ORDBMS + Parallelism != Oil + Water

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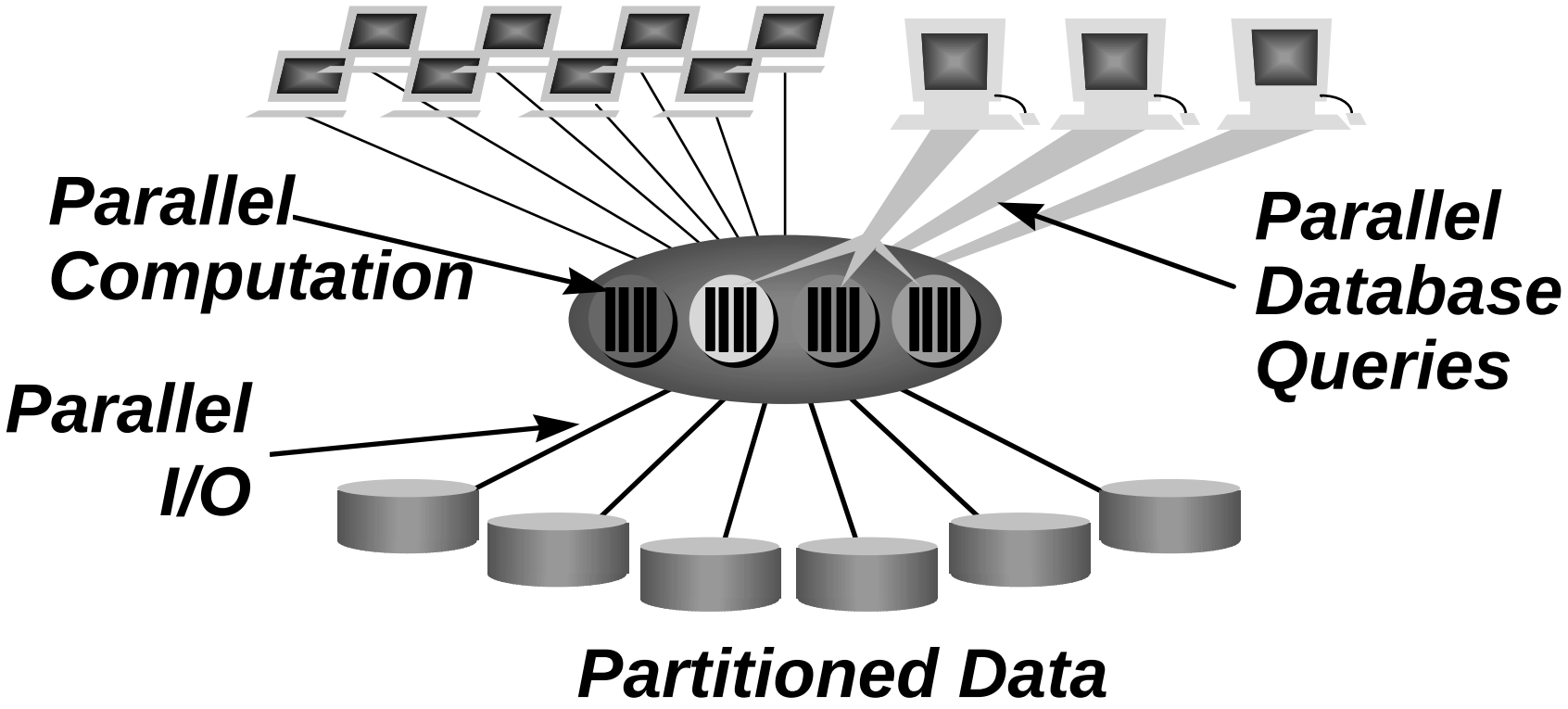
Dynamic Scalable Architecture

- Scalable High Performance



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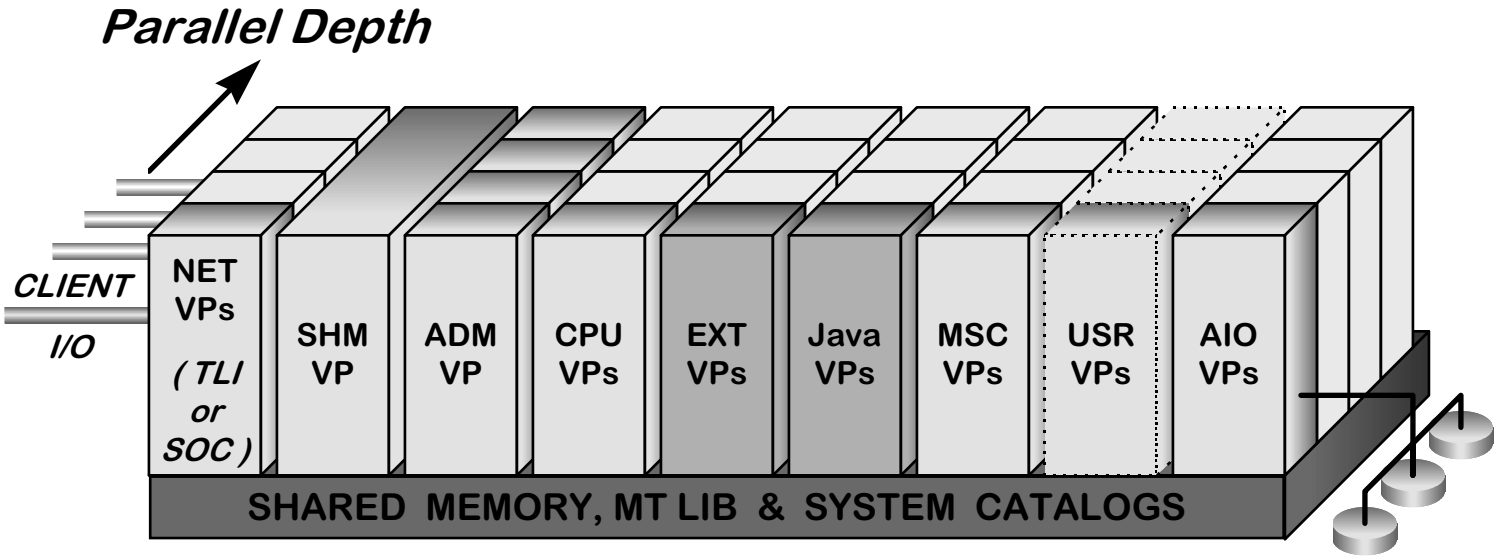
DSA "Virtual Processors"



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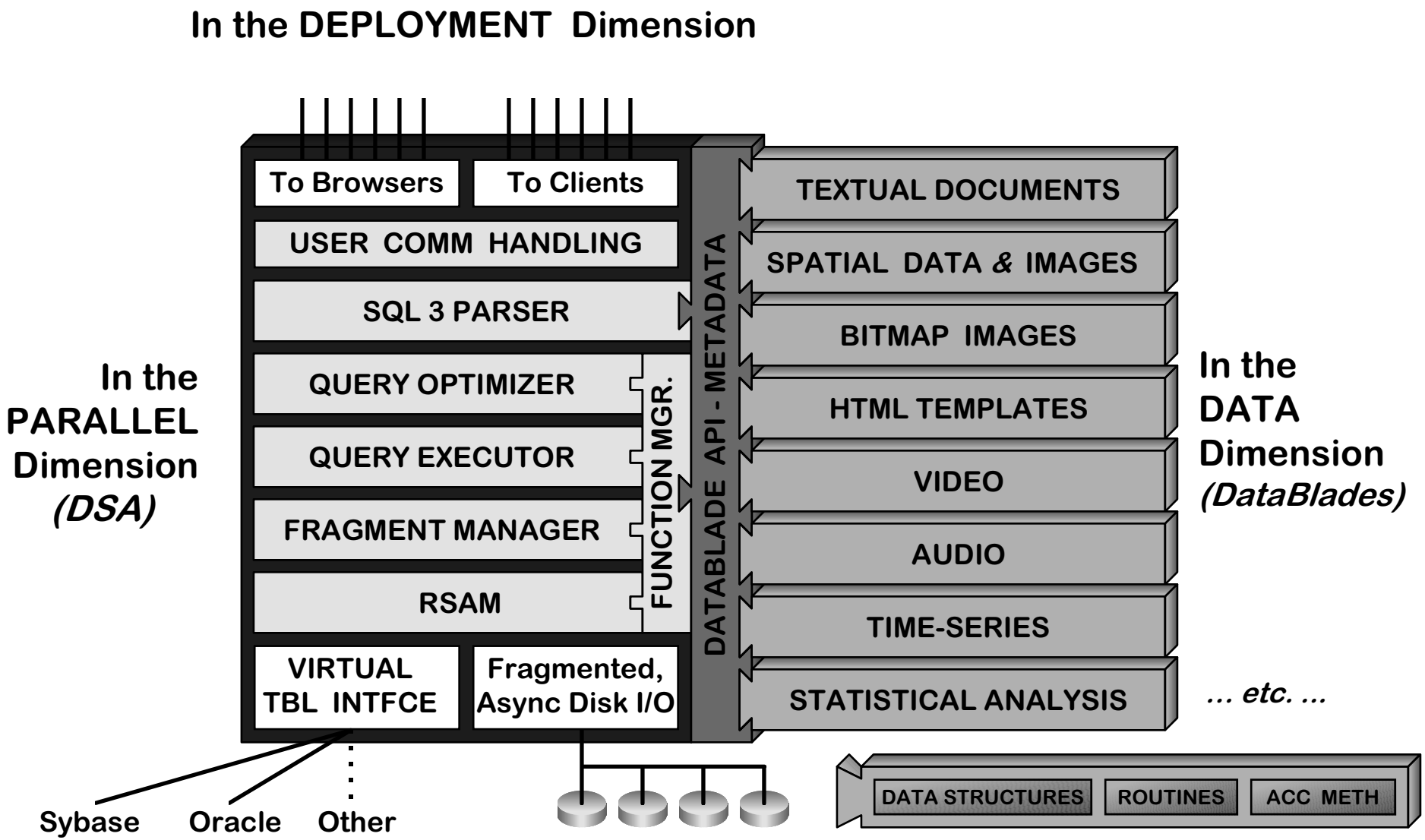
Universal Server Architecture



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IUS New Features

- User-Defined Types
- User-Defined Routines
- User-Defined Access Methods
- DataBlade API

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Type System

- Builtin Types: int, real, varchar, etc.
- Opaque Types (base types): polygon
- Complex Types
  - ➢ Row Types (composite types)
  - ➢ Ref Types
  - ➢ Collections: SET, MULTISET, LIST
  - ➢ User-defined type constructors: TIMESERIES

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All Types Are Created Equal

- "Constitutional Rights" of All Types
  - ➢ column definitions
  - ➢ routine definitions
  - ➢ complex type definitions
  - ➢ casts
  - ➢ inheritance
  - ➢ distinct types
  - ➢ indexing
  - ➢ etc.

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Opaque Types

- by-value/by-ref, size, alignment
- input/output
- send/receive
- assign/destroy
- compare
- hash
- semi-automated by DataBlade Developer's Kit (DBDK)

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Row Types and Ref Types

- named row types

  create row type person_t (name varchar,
  age int, photo image);

  create row type emp_t under person_t
  (salary real);

- unamed row types

  row(x real, y real)

- ref/deref

  create row type fulltime_emp_t under emp_t
  (manager ref(fulltime_emp_t));

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Collection and Constructors

- SET, MULTISET, LIST
- any collection type expression can be used as a table, e.g.,

  select … from TABLE(coll_var) where …;
- subqueries (by default) are typed as multiset of rows
- user-defined type constructors

  create constructor type TIMESERIES …;

  creat table foo (… TIMESERIES(foobar_t) …);

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User-Defined Routines (UDR)

- functions/procedures/aggregates
- just an expression
- routine overloading
- query optimization
- client/server
- well-behaved/non well-behaved
- iterator functions
- extensible language manager

  "builtin", SPL, C, JAVA, "client", ...

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User-Defined Access Methods

- Virtual Table/Index Interface (VTI/VII)
  - ➢ open/close
  - ➢ beginscan/endscan
  - ➢ fetch/update/insert/delete
  - ➢ cost
  - ➢ etc.
- can be fragmented and parallelized
- used for gateways and some in-house datablades: spatial, images, document

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DataBlade API

- currently in C and JAVA
- Same in client and server
- query and connection management
- data and metadata management

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Parallel ORDBMS Issues

- Skews involving complex types
- Intra-UDR parallelism
- spatial data partitioning and spatial joins (not addressed by IUS)

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Skew Example

- relational schema

  create table depts (deptid int, name varchar) fragment by round robin in disk1, disk2;

  create table emps (name varchar, dept int, salary money) fragment by round robin in disk1, disk2;

- "object-relational" schema

  create row type emp_type (name string, salary money);

  create table depts (name varchar, emp set(emp_type)) fragment by round robin in disk1, disk2;

- skew: disk1 may have too many emps

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IUS Solution

- multi-representational storage
  - ➢ small: in-row
  - ➢ large: table files
- column-level fragmentation

  create table depts (name varchar, emp set(emp_type) fragment by round robin in disk1, disk2) fragment by round robin in disk1, disk2;
- will beat relational performance (with same join order)

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Intra-UDR Parallelism

- zero parallelism?

```
-- compute weekly average price for the last 52
-- weeks for informix
select AggregateBy(ApplyClip(stock_prices, ...))
   from securities where symbol = 'ifmx';
```

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Paralell Query Execution

- iterators

  scan, join, mergejoin, hashjoin, sort, group, exchange, etc.

- exchange iterator takes care of all parallelization at run time
- see Goetz Graefe's SIGMOD90 paper:

  "Encapsulation of parallelism in the Volcano query processing system"

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IUS Solution

- iterator functions

  AggregateBy, ApplyClip
- insert exchange nodes in expression tree!

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Summary

- IUS seamlessly incorporates Illustra's Object-Relational functionalities under Informix's Dynamic Scalable Architecture
- Yes, We parallelize everything!

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