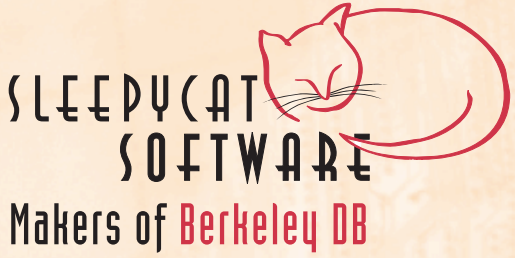
Use a Native XML Database for Your XML Data

You already know it's time to switch.



Gregory Burd • Product Manager • gburd@sleepycat.com

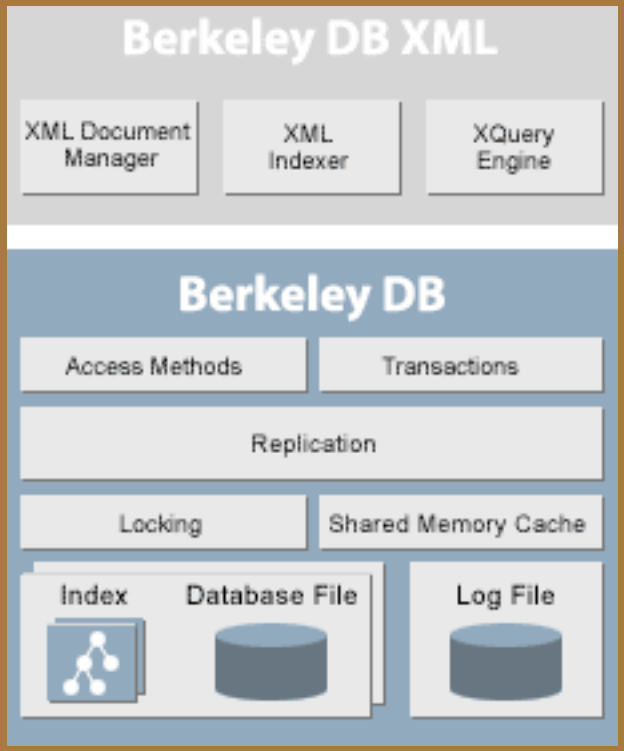
Agenda

- Quick Technical Overview
  - Features • API • Performance
- Clear Up Some Misconceptions
- How to Justify Choosing an XML Database
- Use Cases, Commercial and Open Source
- XML Database Markets
- Product Review

What is Berkeley DB XML?

A native XML database (NXD) with XQuery support.

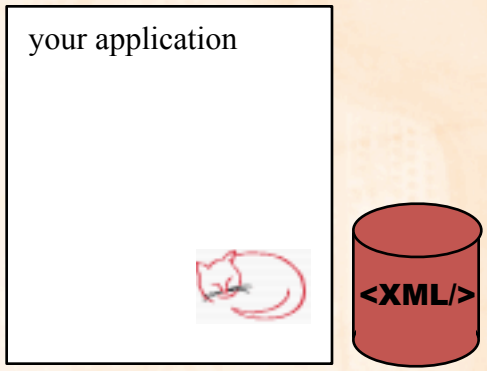
- XML document management
  - storage
  - modification
  - and retrieval
- Scalable
  - millions of documents
  - terabytes of data
- Parse, query, plan, optimize
- ACID Transactions, even XA
- and much more



Berkeley DB XML • Features

a library, linked into your application or server

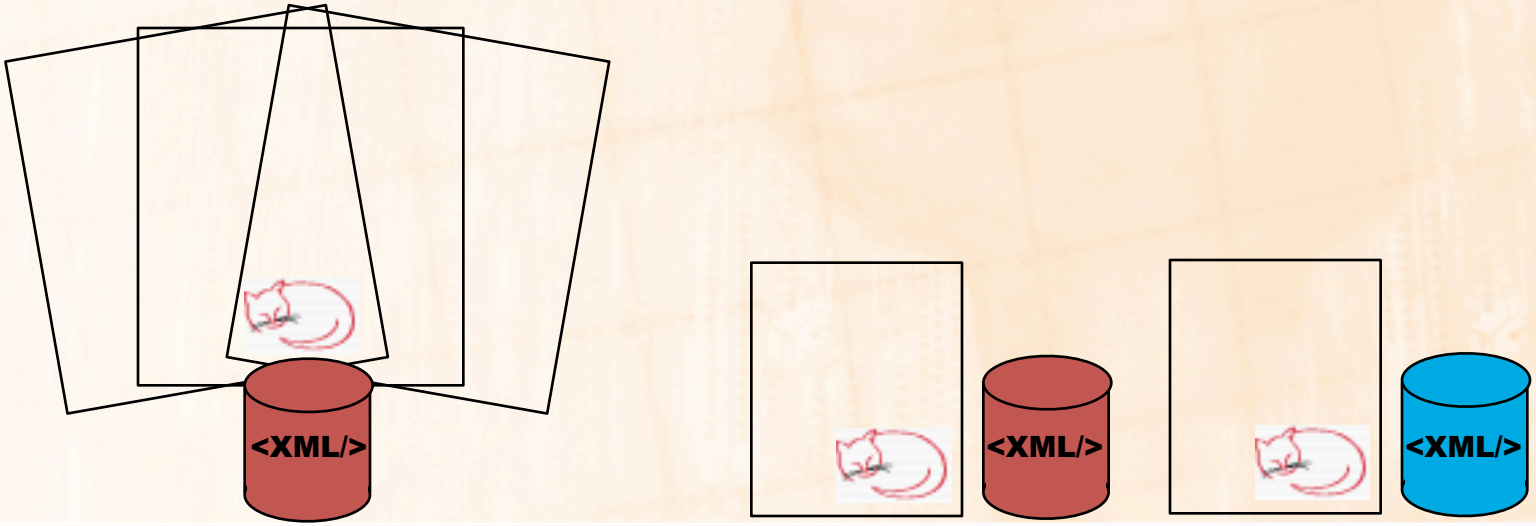
- reduced overhead
- simple installation
- easy administration
- Apache module, PHP API
- could easily become a server, but what standard?
  XDBC? XML:DB? SOAP/WSDL? REST?



Berkeley DB XML • Features

inherits everything from DB

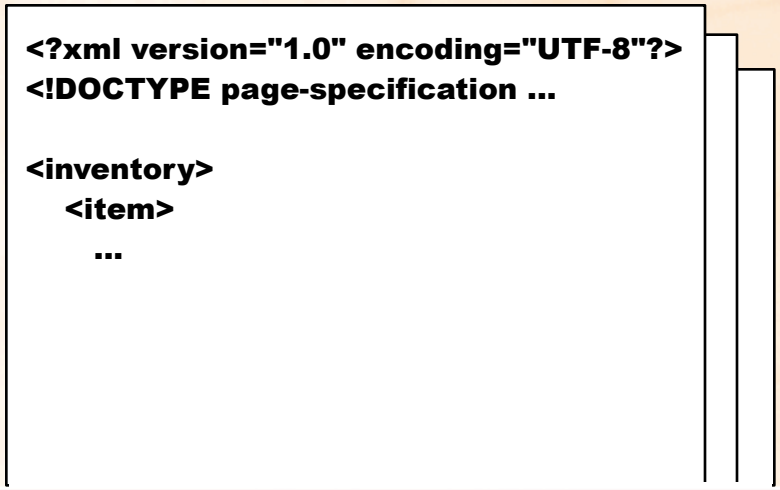
- transactions, concurrency, replication, encryption
- scalable, fast, and resource efficient
- portable, field tested, and proven database technology



Berkeley DB XML • Features

documents

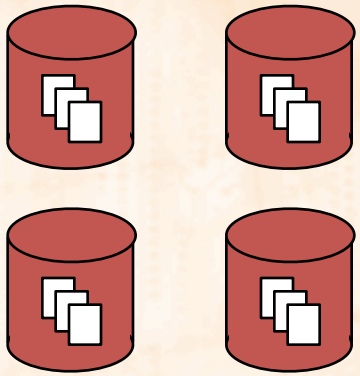
- optional validation
- named UTF-8 encoded documents
- associated, searchable, and indexed meta-data



Berkeley DB XML • Features

containers

- manage groups of documents
- XML stored as nodes or whole documents
- query across multiple containers



Berkeley DB XML • Features

queries

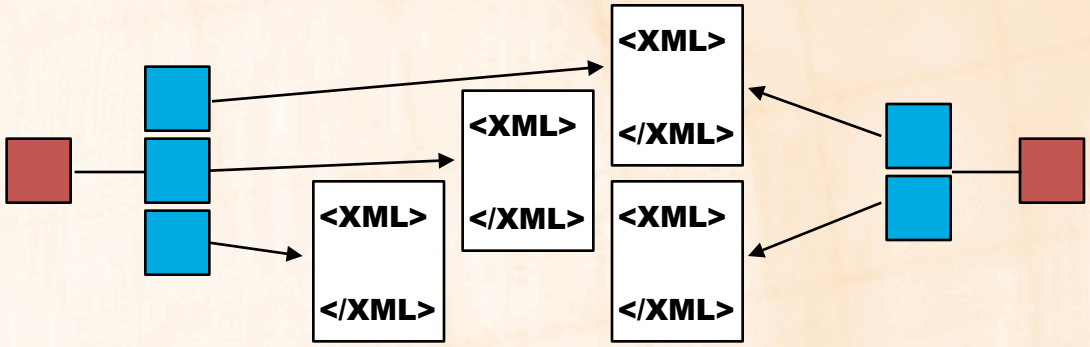
- XQuery and XPath
- eager or lazy evaluation
- pre-compiled queries with variables

```
query '
  for $collection in collection("books.dbxml")/collection
      return <link class="collectiontitle"
                   title="{$collection/@title/.}"
                   idref="{$collection/@id/.}" />
'
print
```

Berkeley DB XML • Features

indexes

- an index is targeted by path, node, key, and syntax type
- human-readable query plans
- add or remove indexes at anytime
- performance at insert(-), update(-) and access(++++)



Berkeley DB XML • Features

dbxml command line shell

- experiment and learn
- administer
- integrate into scripts

```
dbxml>
```

```
$ dbxml -s test.xquery
```

Berkeley DB XML • Features

web site scripting support

- quick prototypes
- use any combination of scripting and compiled concurrently
- LAMP using XML rather than rows and columns

Berkeley DB XML • API

```
// Query for sets of documents within
// namespaces and use variables.

std::cout << “it’s time for some code, let’s begin...”
```

Berkeley DB XML • API

```
// First open and configure the Berkeley DB environment

DbEnv env(0);
env.set_cachesize(0, 64 * 1024 * 1024, 1); // 64MB cache
env.open(path2DbEnv.c_str(),
         DB_INIT_MPOOL|DB_CREATE|DB_INIT_LOCK|DB_INIT_LOG|
         DB_INIT_TXN, 0);

// And now setup a Berkeley DB XML manager

XmlManager mgr(&env);
```

Berkeley DB XML • API

```
// Open an XML document container inside that db environment

XmlTransaction txn = mgr.createTransaction();

std::string theContainer = "namespaceExampleData.dbxml";

XmlContainer container = mgr.openContainer(txn, theContainer);

txn.commit();
```

Berkeley DB XML • API

```
// Create a context and declare the namespaces

XmlQueryContext context = mgr.createQueryContext();

context.setNamespace("fruits",
                     "http://groceryItem.dbxml/fruits");
context.setNamespace("vegetables",
                     "http://groceryItem.dbxml/vegetables");
context.setNamespace("desserts",
                     "http://groceryItem.dbxml/desserts");
```

Berkeley DB XML • API

```
// Perform each of the queries

// Find all the Vendor documents in the database.
// Vendor documents do not use namespaces, so this
// query returns documents.

// ‘doContextQuery()’ is application code, not BDB XML code
//  We’ll look inside the method in a second...

doContextQuery(mgr, container.getName(), "/vendor", context);
```

Berkeley DB XML • API

```
// Find the product document for "Lemon Grass" using
// the namespace prefix 'fruits'.

doContextQuery(mgr, container.getName(),
               "/fruits:item/product[.=\"Lemon Grass\"]",
               context);
```

Berkeley DB XML • API

```
// Find all the vegetables

doContextQuery(mgr, container.getName(), "/vegetables:item",
               context);
```

Berkeley DB XML • API

```
// Set a variable for use in the next query

context.setVariableValue((std::string)"aDessert",
                         (std::string)"Blueberry Muffin");

// Find the  dessert called Blueberry Muffin

doContextQuery(mgr, container.getName(),
               "/desserts:item/product[.=$aDessert]",
               context);
```

Berkeley DB XML • API

```
// Here is the implementation of the method we've been calling

doContextQuery(XmlManager &mgr,
               const std::string &cname,
               const std::string &query,
               XmlQueryContext &context ) {

      try {

            ...
```

Berkeley DB XML • API

```
// Build up the XQuery, then execute it.

std::string fullQuery = "collection('" + cname + "')" + query;

std::cout << "Exercising query '" << fullQuery << "' " <<
std::endl;

std::cout << "Return to continue: ";
getc(stdin);

XmlResults results(mgr.query(fullQuery, context));
```

Berkeley DB XML • API

```
// Here is the loop that gets each match and displays it

XmlValue value;
while(results.next(value))
{
	// Obtain the value as a string and
	// print it to the console
	std::cout << value.asString() << std::endl;
}
```

Berkeley DB XML • API

```
// Now output the number of results we found for the query

std::cout << results.size()
std::cout << " objects returned for expression '"
std::cout << fullQuery << "'\n" << std::endl;
```

Berkeley DB XML • API

```
try {
        ...
    }

    //Catches XmlException
    catch(std::exception &e) {
       std::cerr << "Query " << fullQuery << " failed\n";
       std::cerr << e.what() << "\n";
       exit(-1);
    }

} // end of the method doContextQuery()
```

Berkeley DB XML • API

```
exit(0);

// End of the code, hope you liked it.


This example ships with Berkeley DB XML:

dbxml/examples/cxx/gettingStarted/queryWithContext.cpp
```

Berkeley DB XML • Performance

Quote after evaluating Berkeley DB XML for a production medical records system.

"Frankly we're impressed. We loaded up well over 100,000 documents of moderate size, set up some indices, and then executed some complex XQuery expressions. Most results were around one-tenth of a second."

Berkeley DB XML • Performance

We use XBench to performance test

The benchmark statistics are calculated using the XBench benchmarking toolkit, using data sets of size 20k, 1Mb and 10Mb. The time recorded is for the sum of the three queries, same query for each container size.

The data sets that XBench produces comes in 4 flavors. It creates text centric and data centric data sets, and single document and multiple document data sets. We then run these data sets against both document and node storage, using a set of indexes hand picked to work well with the given data and queries.

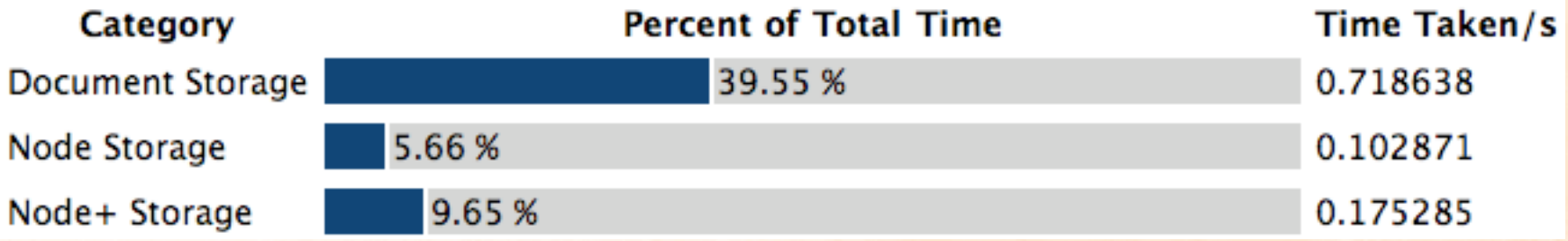
University of Waterloo

Test Machine:
Intel P4 3.0GHz, 1GB RAM, Red Hat 9 Linux

Berkeley DB XML • Performance

TC-MD 16 - Return the titles of articles which contain a certain word ("hockey").

```
for $a in collection()/article
where some $p in $a//p satisfies contains($p, "hockey")
return
    $a/prolog/title
```



Category	Percent of Total Time	Time Taken/s
Document Storage	39.55 %	0.718638
Node Storage	5.66 %	0.102871
Node+ Storage	9.65 %	0.175285

Berkeley DB XML • Performance

Return the names of publishers who publish books between a period of time (from 1990-01-01 to 1991-01-01) but do not have FAX number.

```
for $a in collection()/catalog/item
where $a/date_of_release gt "1990-01-01" and
           $a/date_of_release lt "1991-01-01" and
           empty($a/publisher/contact_information/FAX_number)
return
      <Output>
        {$a/publisher/name}
      </Output>
```

Category	Percent of Total Time	Time Taken/s
Document Storage	41.72 %	2.538966
Node Storage	8.64 %	0.525711
Node+ Storage	3.63 %	0.221001

Berkeley DB XML • Performance

List the orders (order id, order date and ship type), with total amount larger than a certain number (11000.0), ordered alphabetically by ship type.

```
for $a in collection()/order
where $a/total > xs:decimal("11000.0")
order by $a/ship_type
return
    <Output>
        {$a/@id}
        {$a/order_date}
        {$a/ship_type}
    </Output>
```

Category	Percent of Total Time	Time Taken/s
Document Storage	29.6 %	0.209643
Node Storage	20.04 %	0.141901
Node+ Storage	20.23 %	0.143287

Berkeley DB XML • Myths

#1 *"XML is a file format. Repeat after me. A text file format."* (source Slashdot March/2005)

- XML (Extensible Markup Language) is a W3C initiative that allows information and services to be encoded with meaningful structure and semantics that computers and humans can understand.

- XQuery is the query language for XML.
  ... Just as SQL is a query language that queries relational tables to create new relational tables, XQuery queries XML documents to create new XML documents.

Berkeley DB XML • Myths

#2 *"The thing the XML databases are nice for is if folks can't really lock down the schema."*
(source Slashdot March/2005)

- DTD, XSchema and document validation aren't good enough for you? With Berkeley DB XML you can validate on each document differently, or not at all and still query everything at once.

- Sometimes it can be advantageous to not require a schema.

Berkeley DB XML • Myths

#3 *"Lack of mature database features."* (source Slashdot March/2005)

- Most XML solutions are file based, so it is common to confuse implementation with appropriateness.

- Like what? Transactions? Recovery? Encryption? Replication? Hot backup? Scale? Caching? XA? 24x7 operations? We've got all that and more.

Berkeley DB XML • Myths

#∞ *"Ignorance of the decades of scientific research and engineering experience in the field of relational database management systems, relational algebra, set theory and predicate calculus; lack of real atomicity of transactions, lack of guaranteed consistency of data, lack of isolated operations, lack of real durability in the ACID sense, and in short, the lack of relational model; scalability, portability, SQL standard, access to your data after two years and after twenty years; to name just a few."*

(source Slashdot March/2005)
http://developers.slashdot.org/article.pl?sid=05/03/10/2043202&tid=221

Berkeley DB XML • Justify

- Do you have thousands of XML files?
- Is your XML data larger than 200MB?
- Are you trying to build a hierarchy into tables?
- Could your data change over time?
- Have you spent more that $100 on books explaining SQLXML?
- Are you waiting for the next release of some RDBMS to fix your performance problems?

Berkeley DB XML • Use Case

Searching for a nice place to stay?

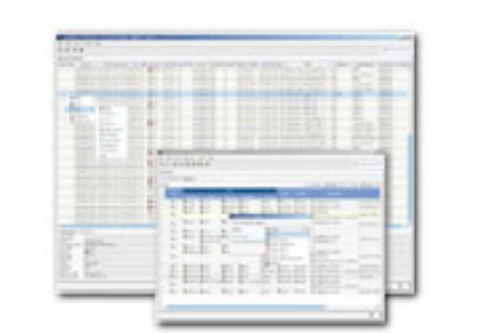
If you're searching Starwood, you're using Berkeley DB XML.

Starwood Hotels

STARWOOD
HOTELS & RESORTS WORLDWIDE, INC.

Berkeley DB XML • Use Case

The Juniper NetScreen Security Manager has to determine what is a threat,



the threat reports live in Berkeley DB XML.

Juniper

Berkeley DB XML • Use Case

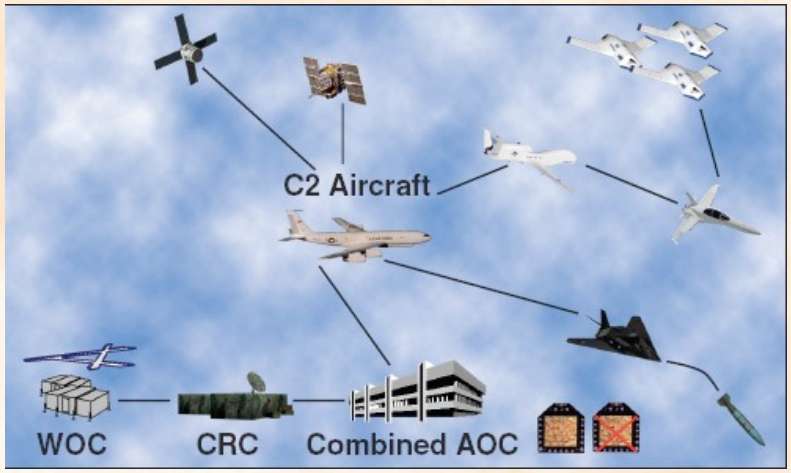
Mass amounts of data for financial models models in XiMoL

XML objects reside in Berkeley DB XML.

Zeliade

Berkeley DB XML • Use Case

Publish and subscribe integration with XML messages,



where the data moves through Berkeley DB XML.

USAF Research Labs

Berkeley DB XML • Use Case

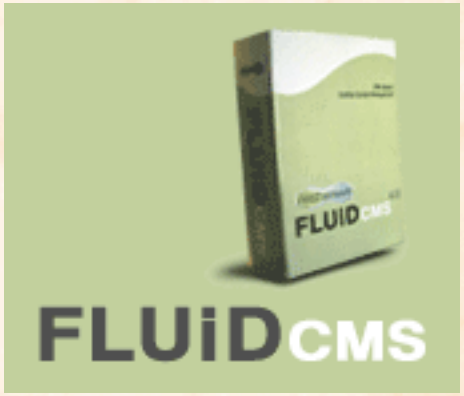
Your prescription drug history may be stored as XML...

in Berkeley DB XML.

Berkeley Medical

Berkeley DB XML • Use Case

Zero programming next generation XML based content management...



and the content resides in Berkeley DB XML.

Feedstream

Berkeley DB XML • Open Source

An open source XML content publication system written in Python,

built on top of Berkeley DB XML.

Syncato

Syncato
A content management system for the little things

Berkeley DB XML • Markets

- Research
- Notification
- Integration
- Bioinformatics/Genomics
- Security
- Content Management
- The ‘X’ in LA~~M~~P

Berkeley DB XML • Review

InfoWorld

By Rick Grehan

Highest rating ever given ->

Sleepycat Berkeley DB XML 2.0

Sleepycat Software, sleepycat.com

Excellent 9.3

criteria	score	weight
Interoperability	10	20%
Performance	9	20%
Scalability	9	20%
Setup	9	20%
Documentation	9	10%
Value	10	10%

Cost:
Free *[use in open source]*

Platforms:
Supports all major OSes

Bottom Line:
Berkeley DB XML is a killer XML database library running a layer above the bulletproof Berkeley DB. Sleepycat has improved this latest version greatly, adding XQuery support, the ability to manage large files with per-node storage, and new documentation to flatten the learning curve.

(source InfoWorld May/2005)
http://www.infoworld.com/article/05/05/23/21TCxmldb_2.html

Berkeley DB XML • Release

Now available, Berkeley DB XML 2.2

- Node level indexes
- Optimized query planning and intelligent indexing
- Faster path expression evaluation and predicate evaluation
- Optimized resource utilization
- Efficient type casting
- New index lookup functions
- Supports the April 2005 drafts of XQuery 1.0 and XPath 2.0

And 500% or better improvement in average query speed!

Berkeley DB XML

Makers of Berkeley DB

Gregory Burd • Product Manager • gburd@sleepycat.com