

Case Studies in Hardware Xpath Acceleration

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Main Goal and Results.

Acceleration of Xpath processing by Hardware in two real world applications – **WBM** and **DB2-pureXML**.

Websphere Business Monitor – 27% improvement in total running time.

DB2-pureXML – up to x6.2 improvement in total query processing time.

IBM's Power Edge of Network (PowerEN)



6. XSLT transformation

XPath compiler

5. XPath Matching (filtering/tagging)

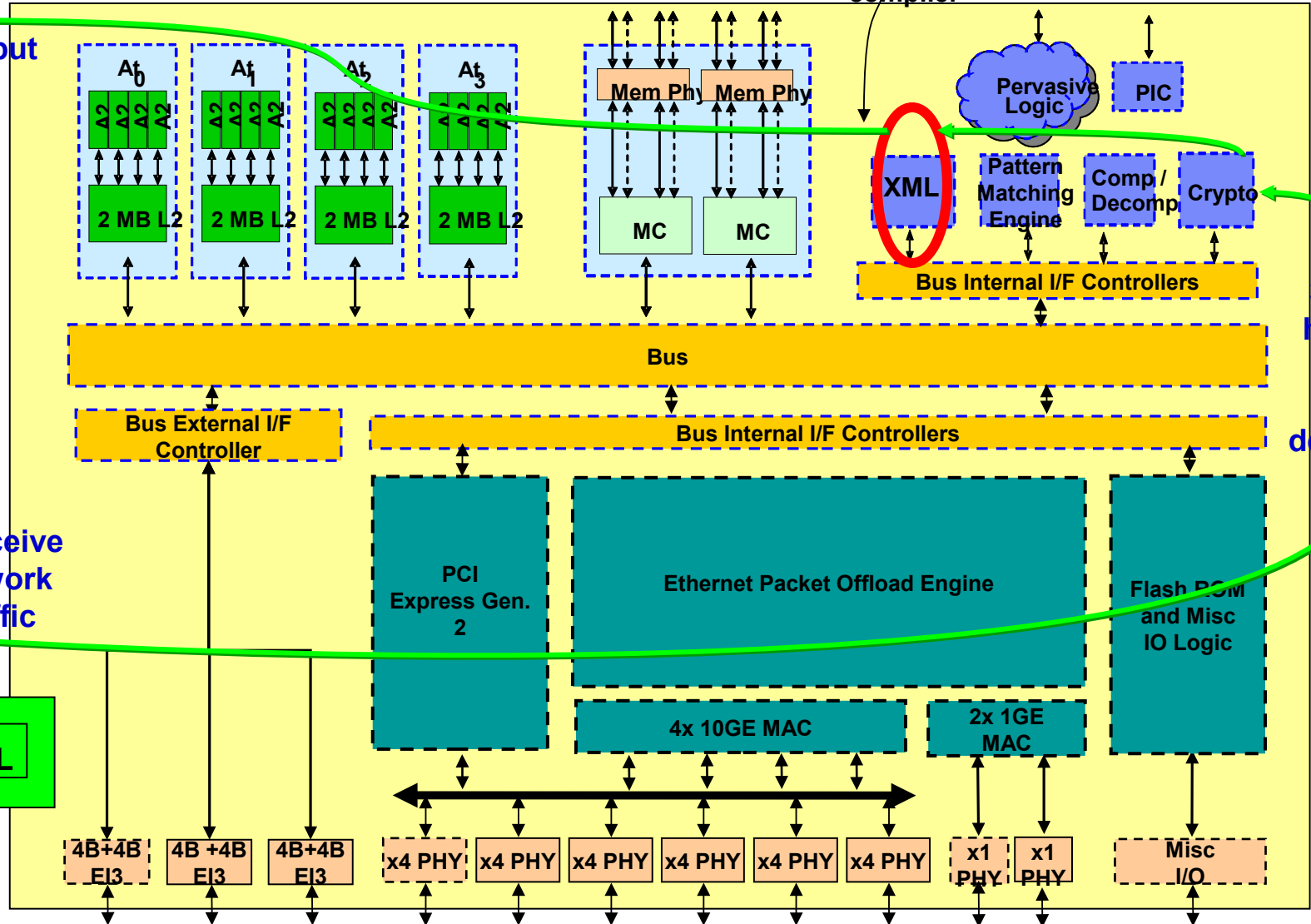
4. XML parsing

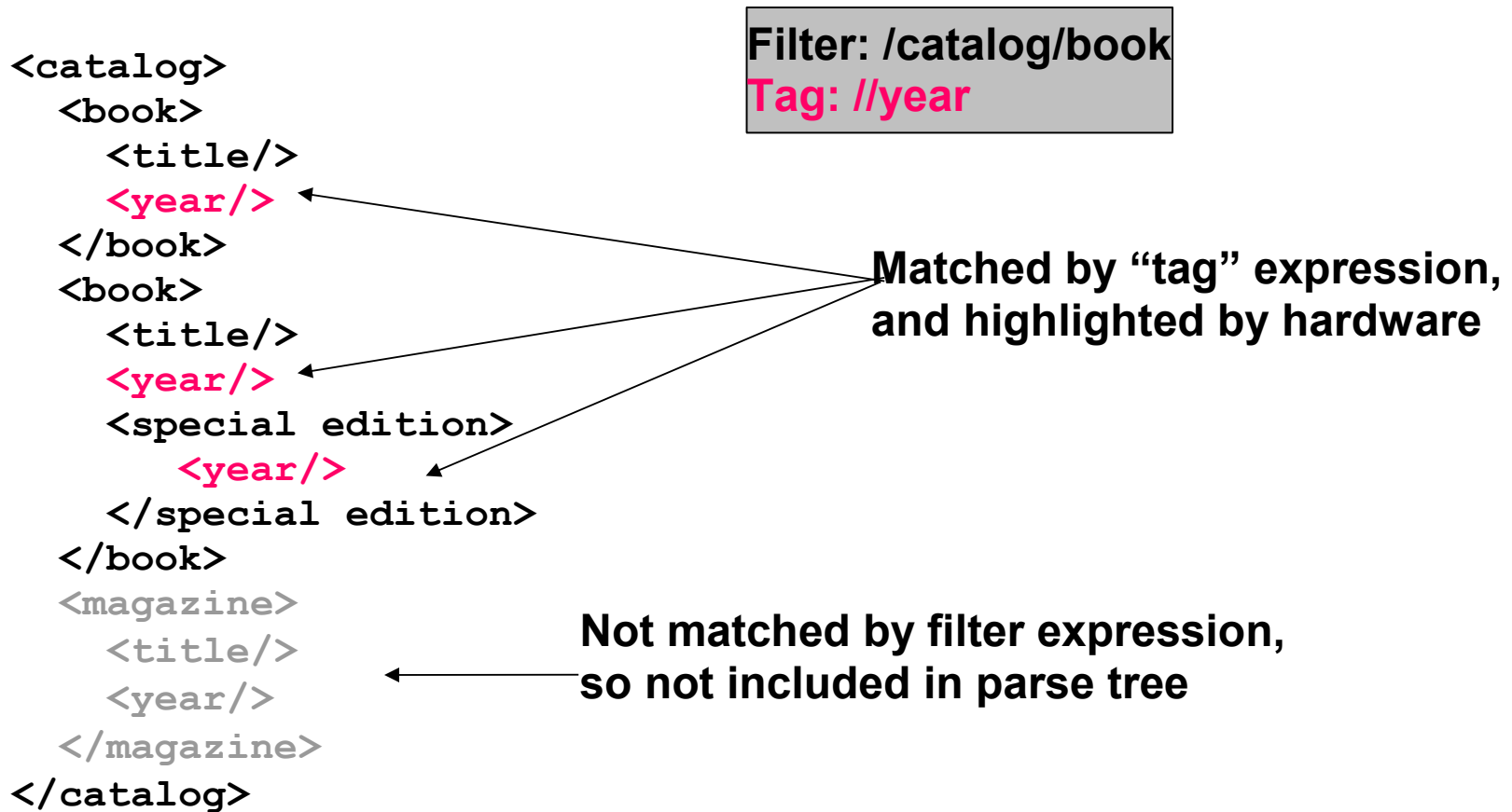
7. output

1. receive network traffic

3. HTTP handling
2. SSL decryption

XML

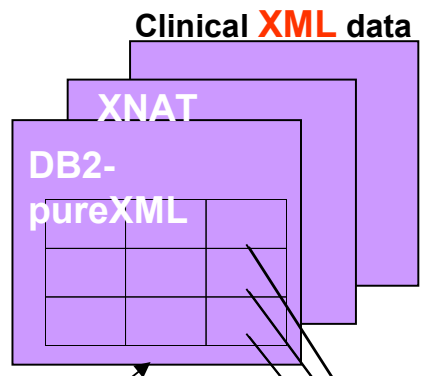




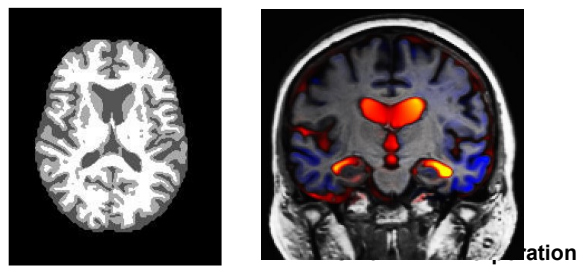
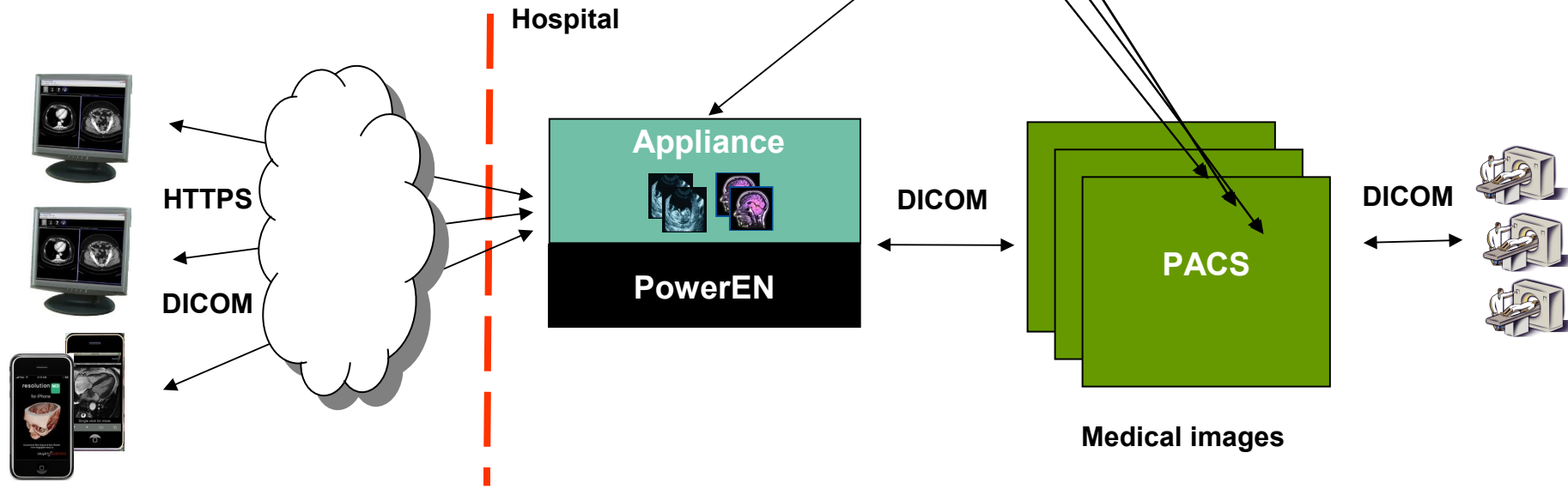
XPath is a language used to navigate through elements and attributes in an XML document

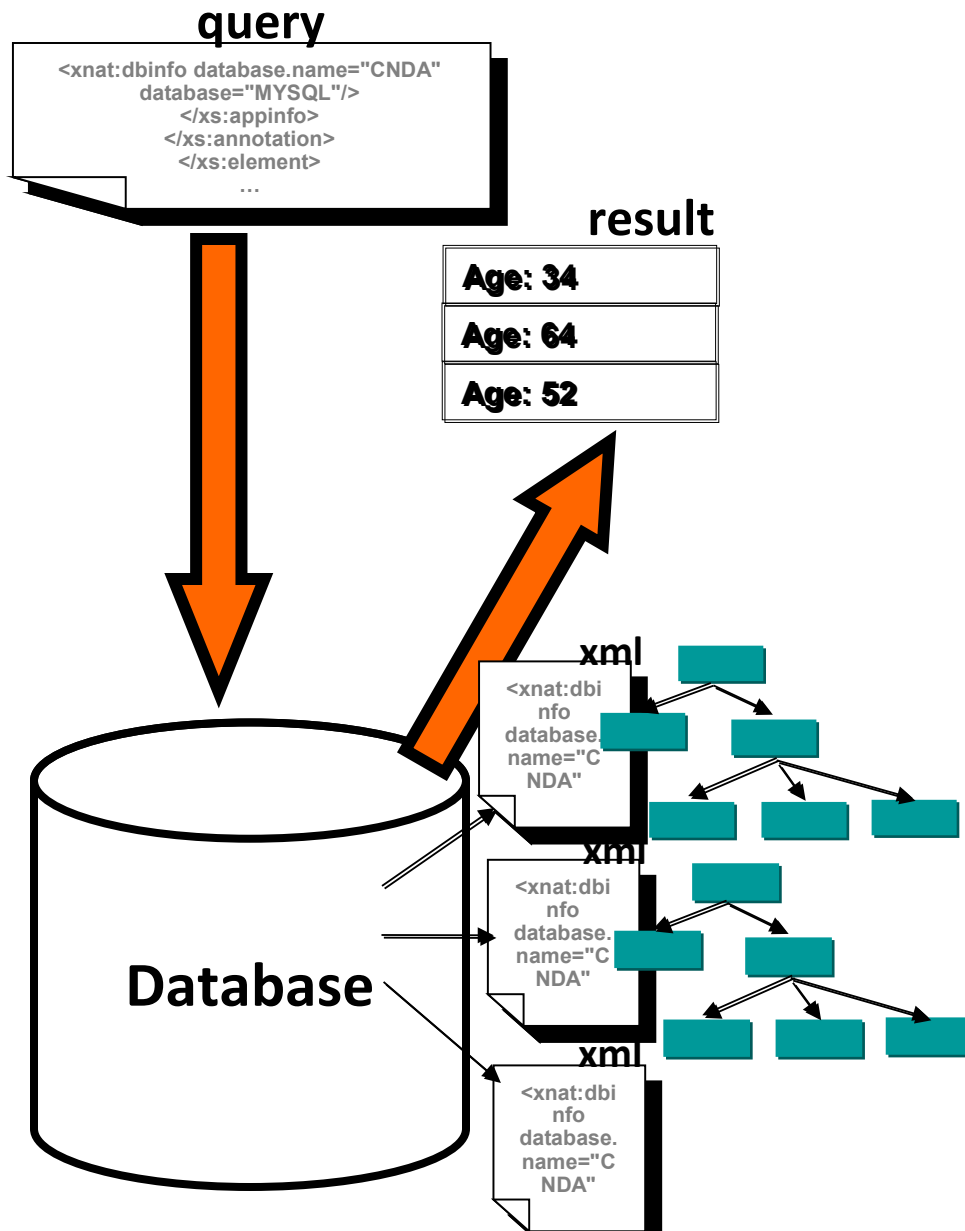
XPath acceleration opportunities: 1) XML in Healthcare / XML Databases

```
<SubjectData ID="ab123">  
<gender>male</gender>  
<handedness>left</handedness>  
<dob>1967-08-13</dob>  
<education>30</education>  
<ses>2</ses>  
</SubjectData>
```



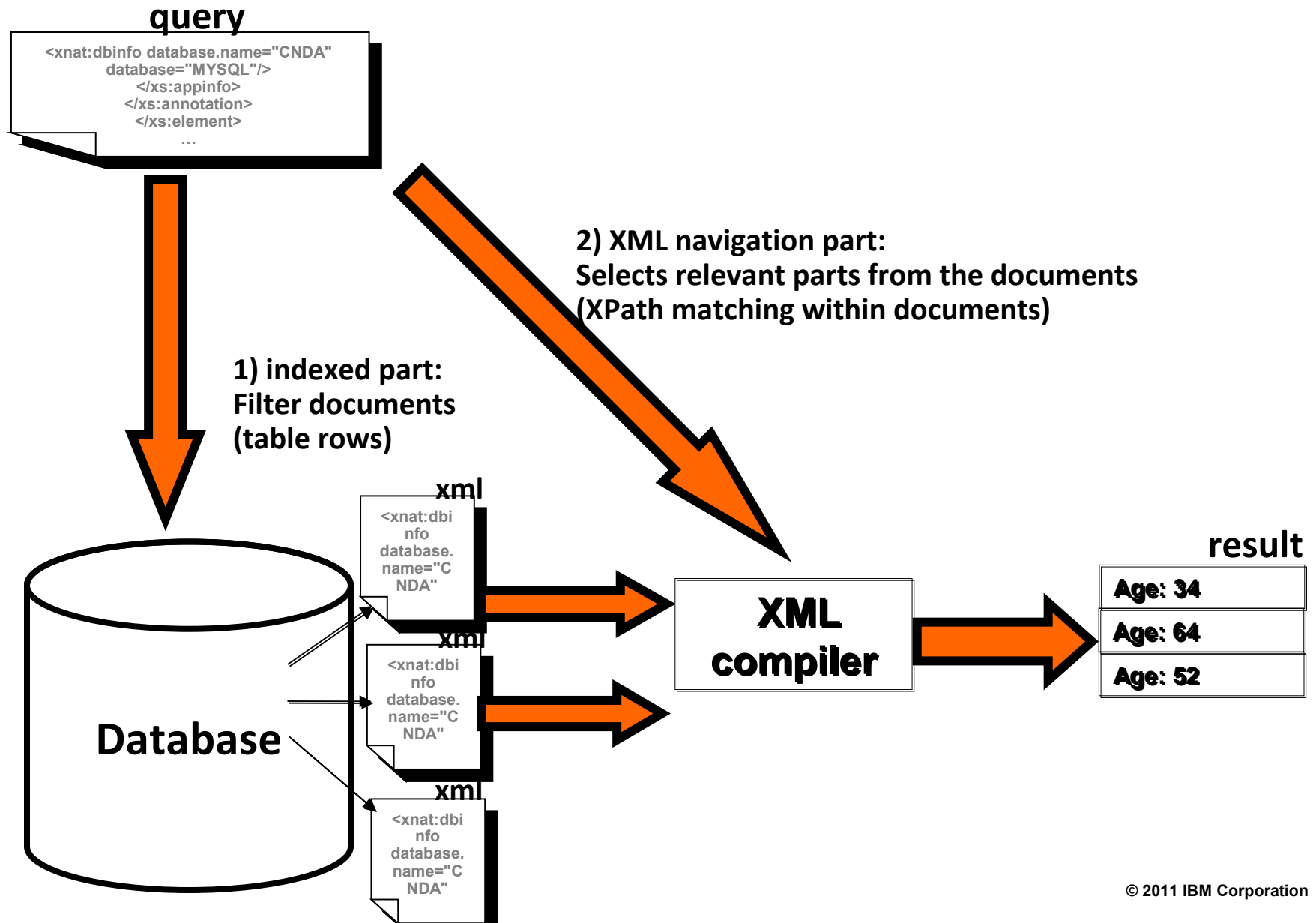
XML: de-facto standard for electronic medical health record interoperability





Processing may consist of:

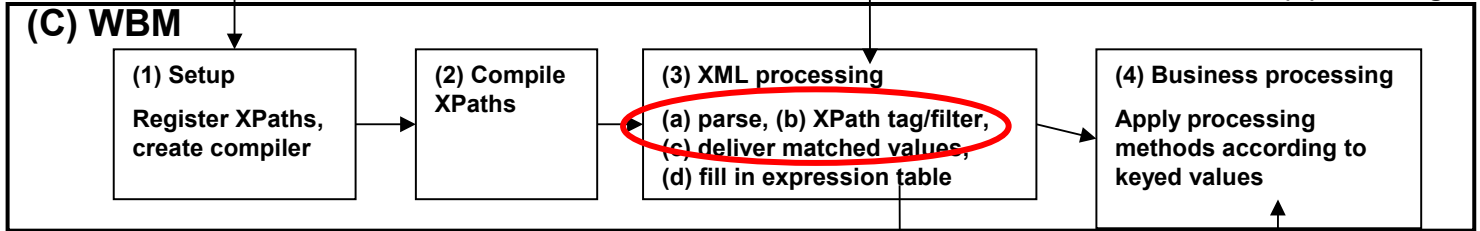
1. Table operations on indexed elements
2. Navigation of the XML documents



- (A) XPath expression list
- 1: cbe:CommonBaseEvents/cbe:CommonBaseEvent/@globalInstanceId
 - 2: cbe:CommonBaseEvents/cbe:CommonBaseEvent/@creationTime
 - 3: wbi:event/wbi:eventHeaderData/wbi:ECSCurrentID/text()
 - 4: wbi:event/wbi:eventHeaderData/wbi:ECSParentID/text()
 - 5: wbi:event/wbi:eventPointData/wbi:eventNature/text()
 - 6: wbi:event/wbi:eventPointData/bpc:processTemplateName/text()
 - 7: wbi:event/wbi:eventPointData/bpc:bpelId/text()

```
>cbe:CommonBaseEvents<
="...">cbe:CommonBaseEvent globalInstanceId="..." creationTime <
cbe:contextDataElements name="WBIEventVersion" <
">type="string
>cbe:contextValue>6.1</cbe:contextValue <
cbe:contextDataElements> </
> <wbi:event
>wbi:eventHeaderData <
>wbi:ECSCurrentID>...</wbi:ECSCurrentID <
>wbi:ECSParentID>...</wbi:ECSParentID <
>wbi:eventPointData <
>wbi:eventNature>ENTRY</wbi:eventNature <
>bpc:BPCEventCode>21000</bpc:BPCEventCode <
>bpc:processTemplateName>...</bpc:processTemplateName <
>wbi:eventPointData </
>wbi:event </
>cbe:CommonBaseEvent </
>cbe:CommonBaseEvents</
```

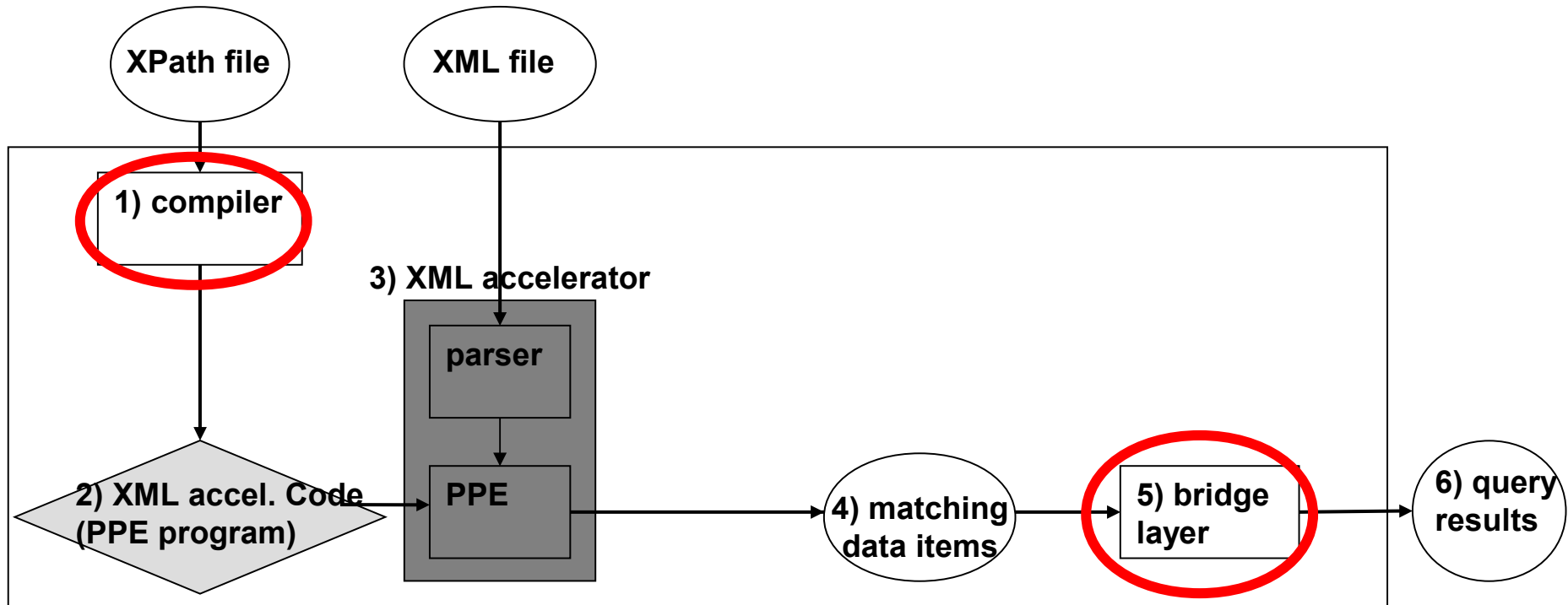
(B) Incoming CBE event



(D) expression keyed table of matching values

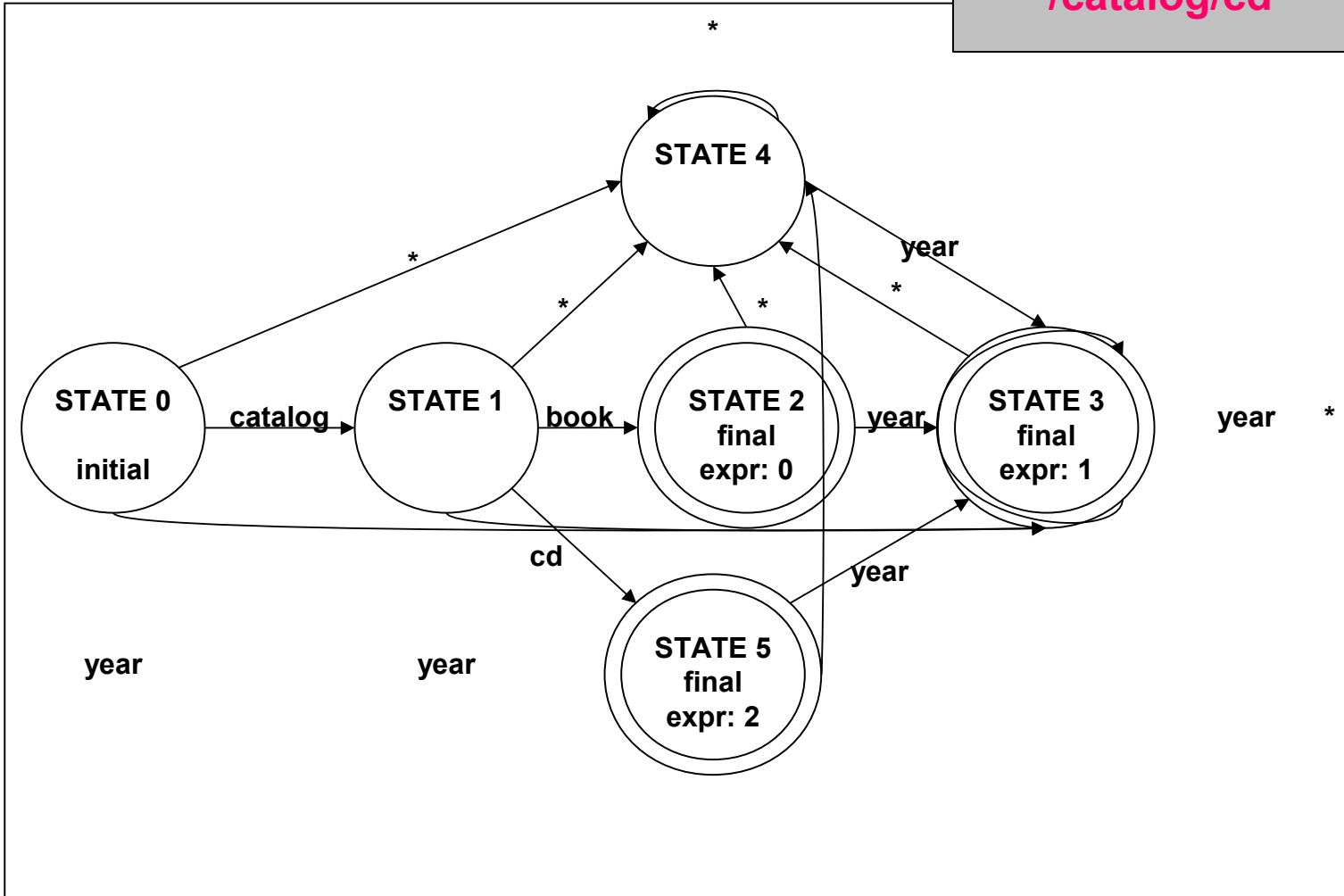
Key	Value
1	globalInstanceId="..."
2	creationTime="..."
3	<wbi:ECSCurrentID>...</wbi:ECSCurrentID>
4	<wbi:ECSParentID>...</wbi:ECSParentID>
5	<wbi:eventNature>ENTRY</wbi:eventNature>
6	<bpc:processTemplateName>...</bpc:processTemplateName>
7	null

Technical details



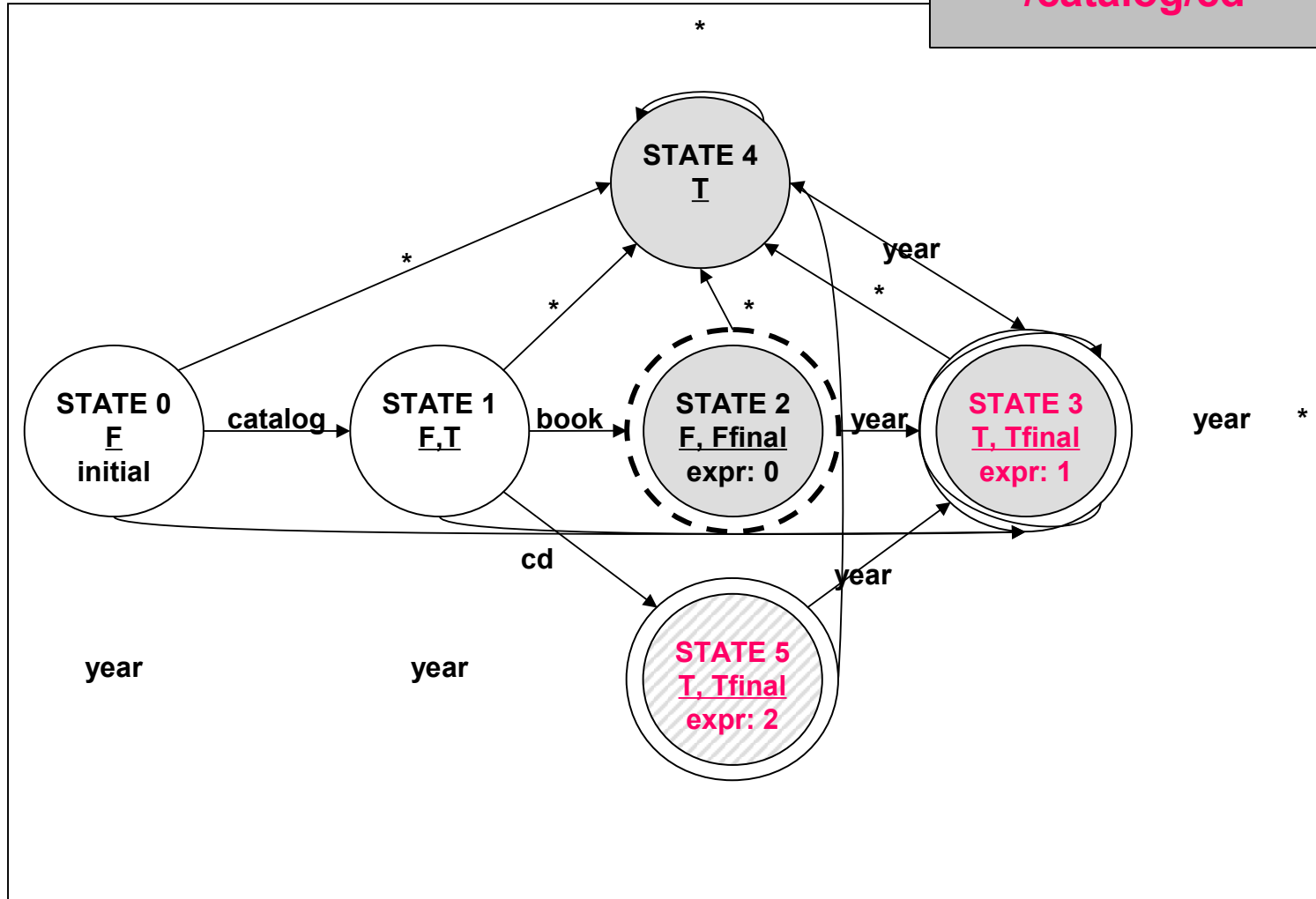
A few technical details: 1) the XPath compiler

Filter: /catalog/book
Tag: //year
/catalog/cd



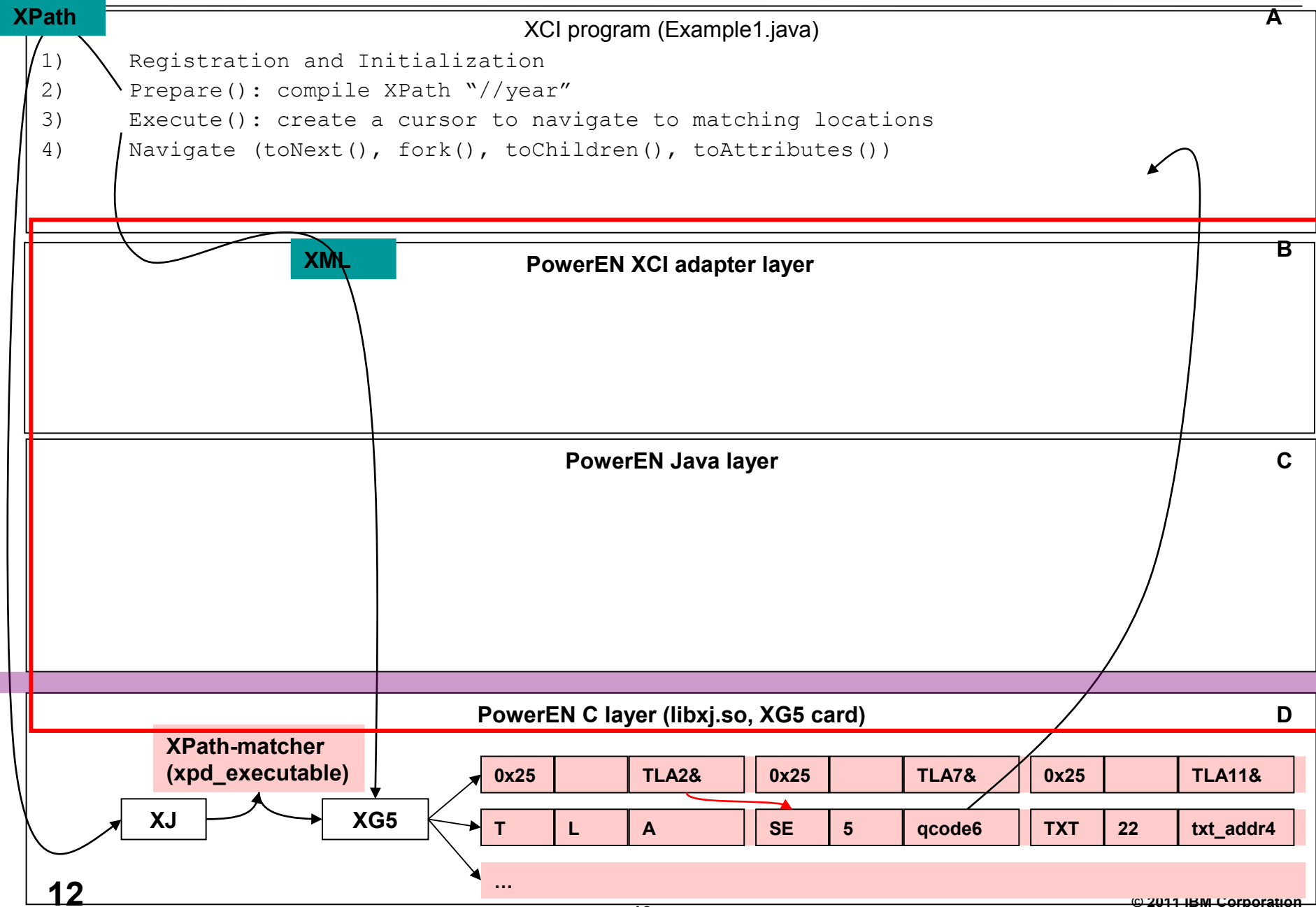
A few technical details: 1) the XPath compiler - con

Filter: /catalog/book
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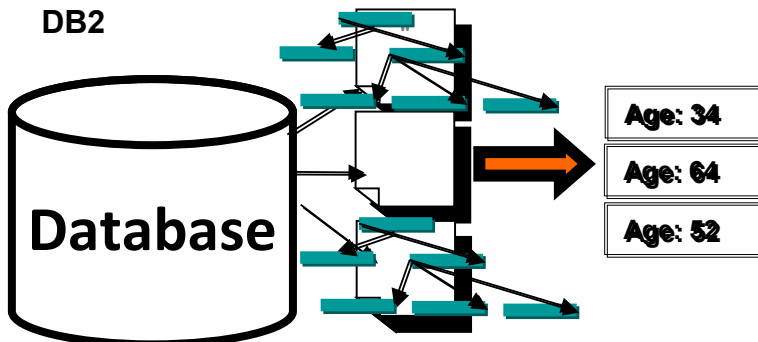


Note: streamable XPaths only (don't support /catalog/book[special-edition]/year)

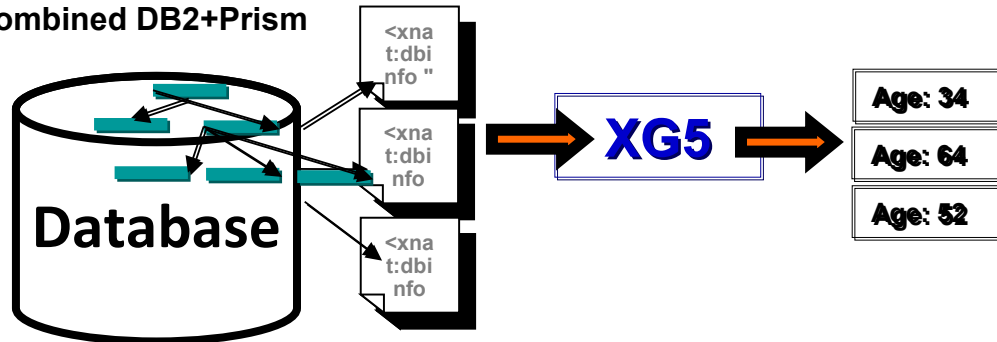
A few technical details: 2) the bridge layer



DB2



Combined DB2+Prism



(1) Filter documents (rows)

(2) Navigate the parsed document to find matches

(3) Serialize the results

(4) Transmit the results to the client

(1) DB2 filter and serialize documents

(2) Send the XML document from host to Prism

(3) Parse the document to find matches
(+ compile the XPath query into a program that would run on the XML accelerator)

(4) Send the results back to the host

(5) Serialize the results

(6) Transmit the results to the client

Processor:

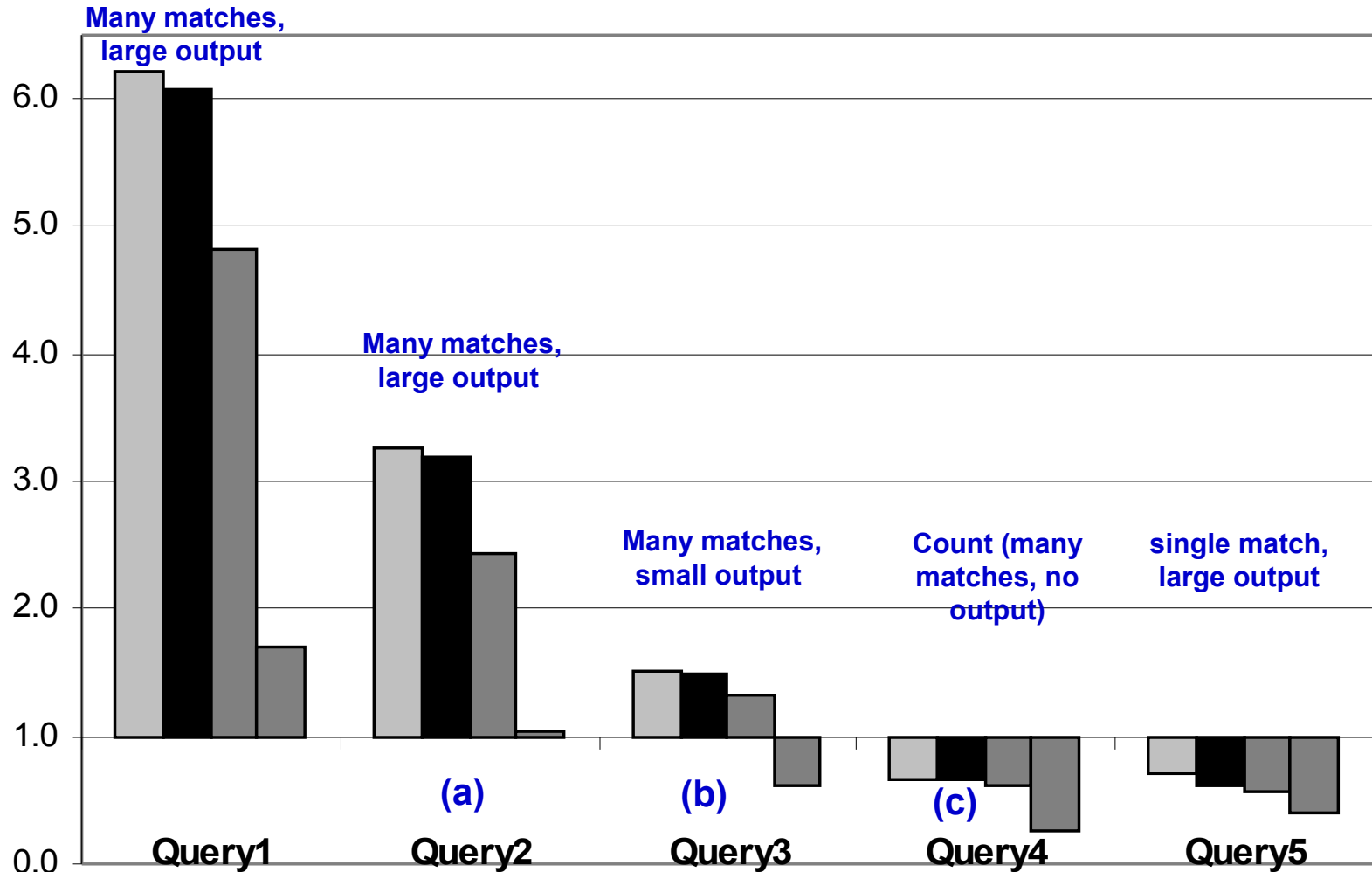
- 1) dual x86 Harpertown Processors @2.83GHz

Processor:

- 1) dual x86 Harpertown Processors @2.83GHz
- 2) PRISM offloading the XML processing

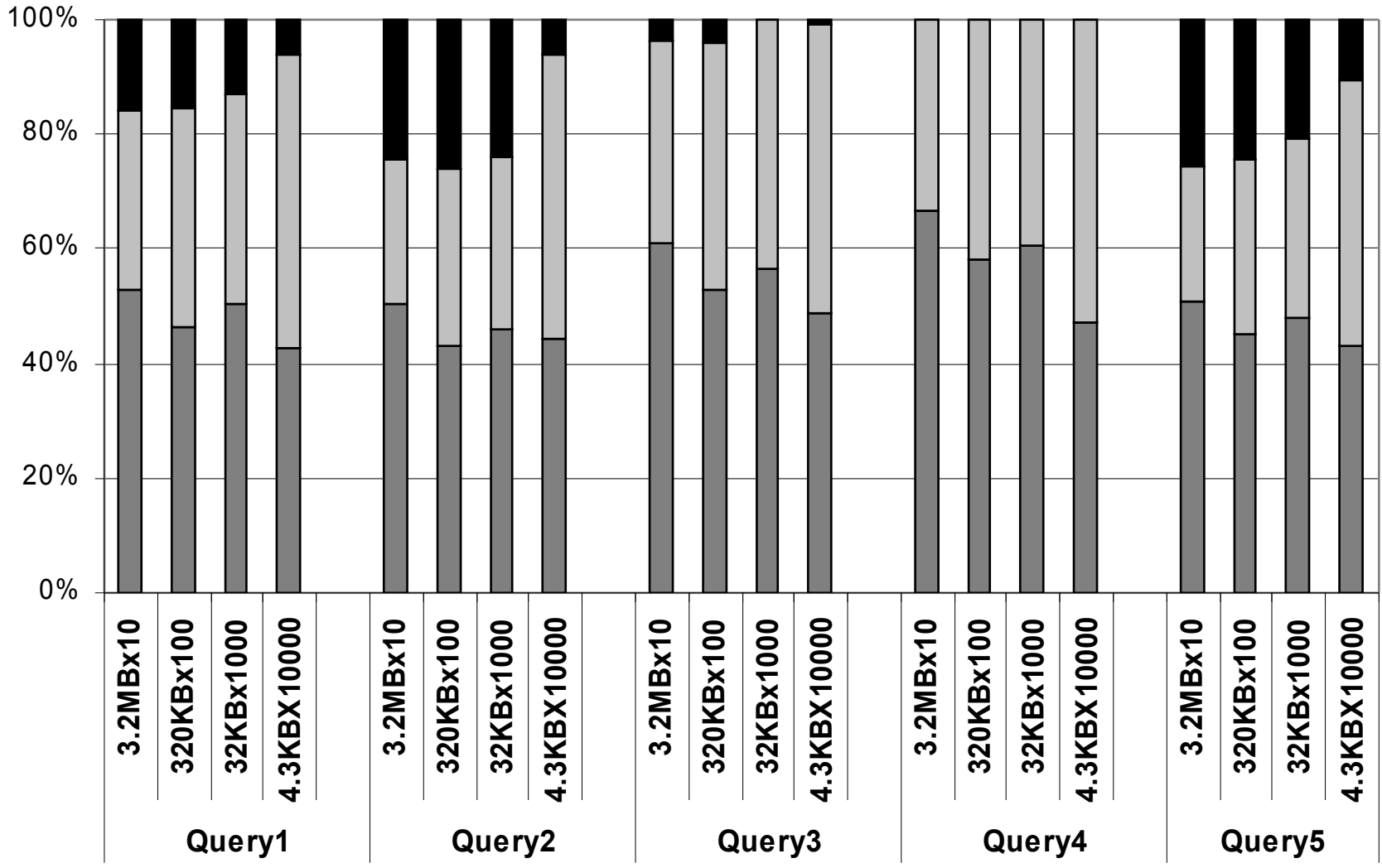
XPath query acceleration speedups, HL7

3.2MBx10
 320KBx100
 32KBx1000
 4.3KBX10000



Breakdown of accelerated path, HL7 query

■ DB2 read and serialize documents □ process query ■ serialize results



Many matches, large output

(a) Many matches, large output

(b) Many matches, small output

(c) Count (many matches, no output)

single match, large output

Websphere Business Monitor acceleration speedups


- **XML processing part improved by 27% → WBM Overall application improved by 11%**

An efficient bridging layer is critical for overall accelerated performance

- buffering of requests to the accelerator
- reduced JNI calls/Java–C conversions

Applications have to use the “right” API

Conclusions:

- High potential for acceleration can be found in applications using **large documents** and XPath queries **matching large numbers of XML nodes and producing large outputs**, such as in the **healthcare and life sciences domains**. 
- Limited potential for acceleration can be found in applications using small documents and XPath requests matching small numbers of XML nodes or producing small outputs, such as in the **event processing and financial domains**.
- An **efficient bridging layer** is critical for overall accelerated performance. Optimizations to the software bridging layers, such as buffering of requests to the accelerator, reduced JNI calls and Java–C conversion overheads, yielding a 33% improvement to the WBM accelerated path, and up to 2.7x improvement to the HL7 accelerated query processing path.

Future Work

- extend the applicability of XPath acceleration coprocessors

- increase speedups:

Devise a **cost model** that can automatically identify scenarios that can profit from XPath acceleration.

Extend XML APIs to express more involved XPath scenarios (such as simultaneous filtering and tagging, and multi-step XML processing).

Specifically in the native XML Database domain, data serialization costs are relatively high, and support for **compact data formats** by the hardware XPath accelerator is critical.

The End

Questions?