Distributed Computing in Algebraic Topology: first trials and errors, first programs

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Introduction

EAT (Common Lisp) / KENZO (CLOS)

SYSTEMS FOR SYMBOLIC COMPUTATION IN ALGEBRAIC TOPOLOGY

$H_5(\Omega^3 \text{Moore}(Z_2, 4))$ ⟹ $(Z_2)^5$

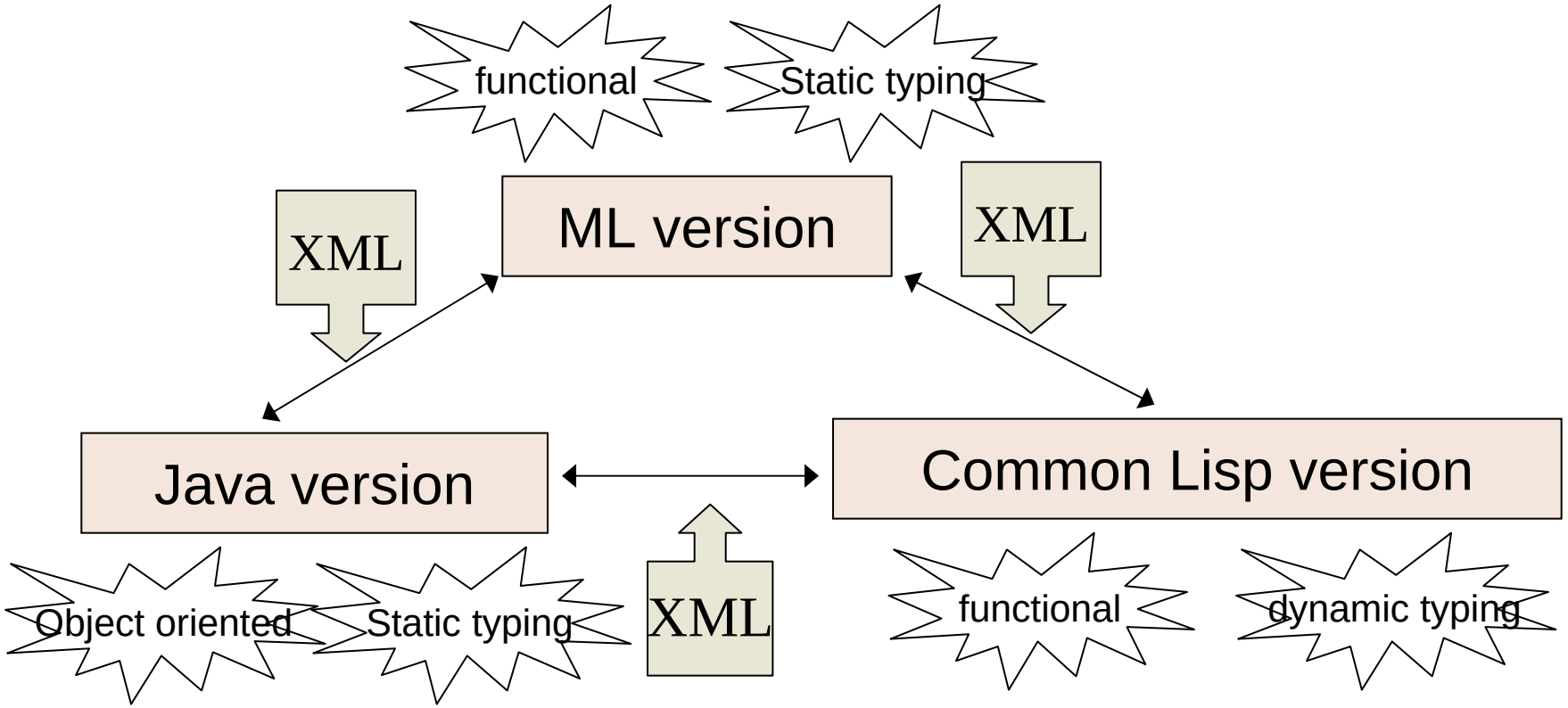
```
>(homology (loop-space (moore 2  4) 3) 5)

homology  in dimension 5:
        Component Z/2Z
        Component Z/2Z
        Component Z/2Z
        Component Z/2Z
        Component Z/2Z
```

- Intensive use of functional programming.
- Discovery of unknown results.
- Usability??
- Remote access??

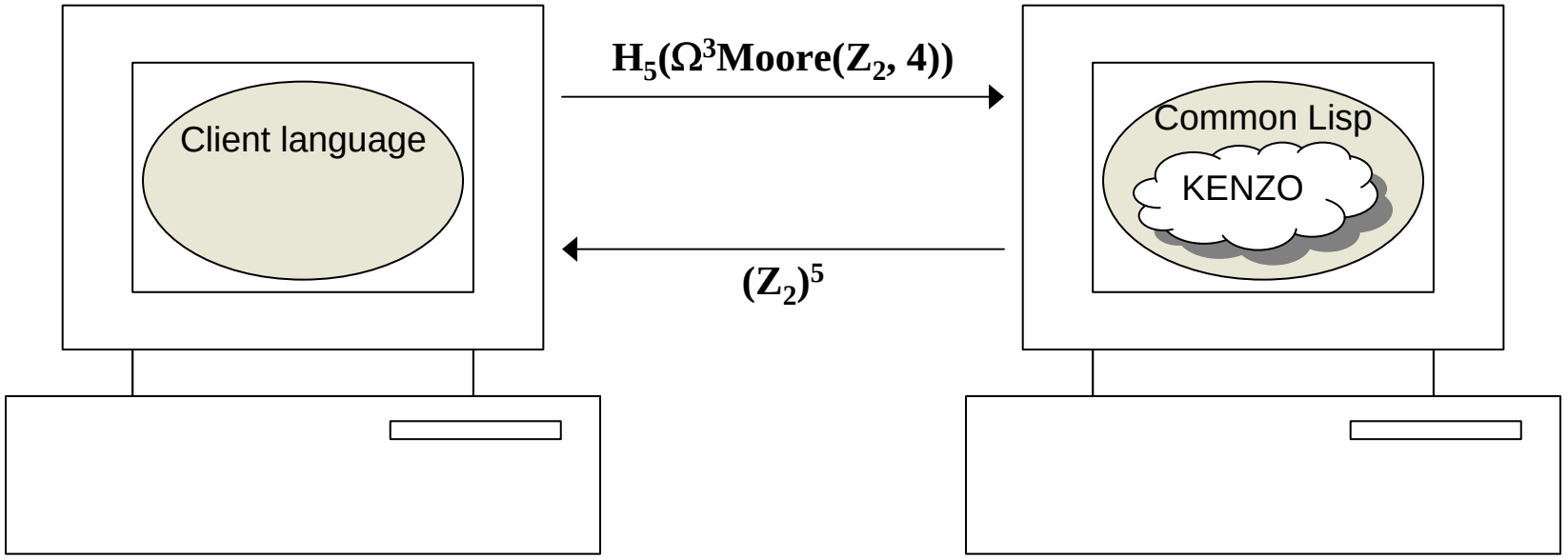
Previous Work

- Reconstruct (part of) them in Java. As an intermediate step: ML.
- To interoperate between the three versions: XML (extending MathML)



only in a local non-distributed way

Goal: distributed computing



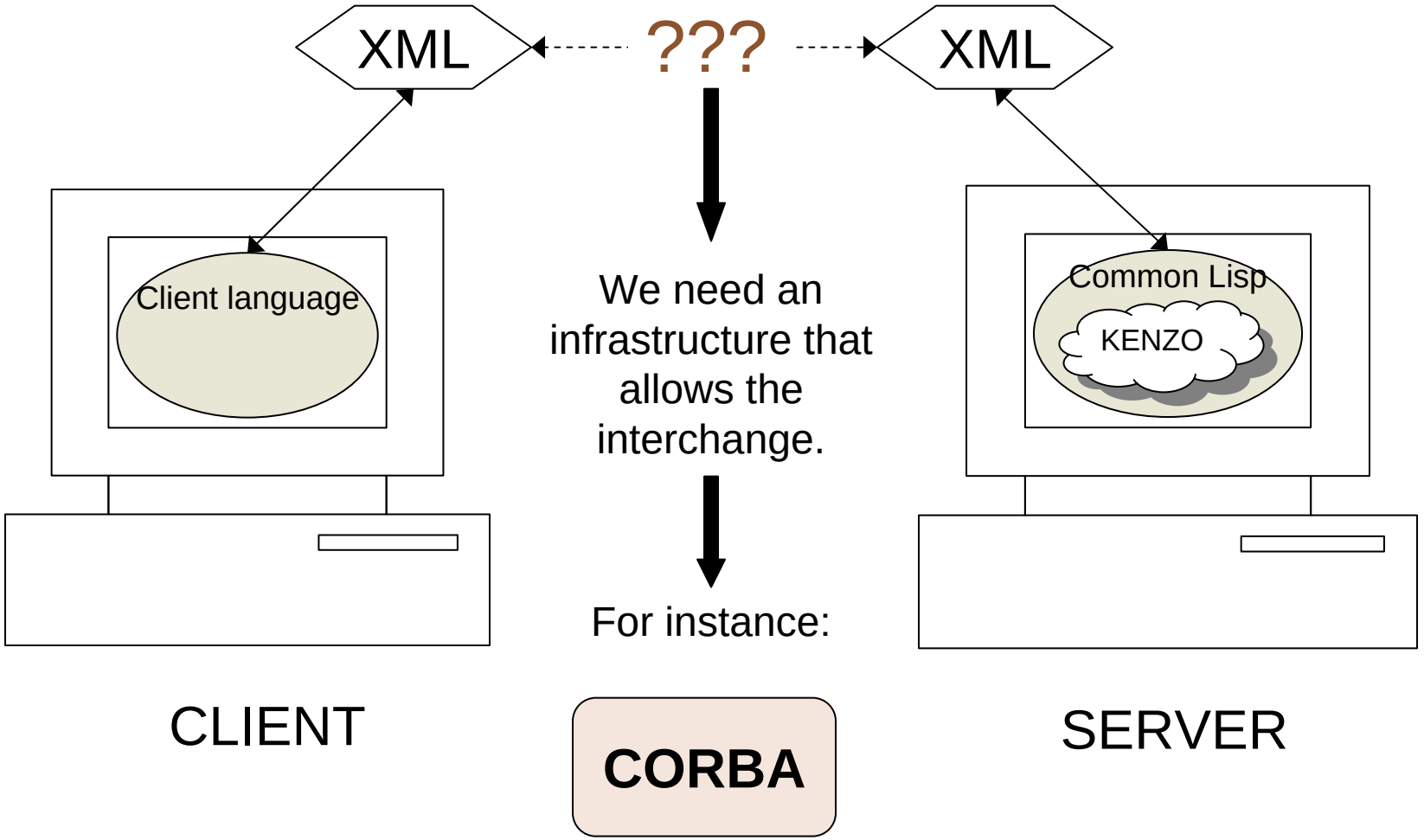
CLIENT SERVER

Important features of EAT and Kenzo:

- Very time and space consuming.
- Written in Common Lisp.
- Higher order functional programming (infinite data structures).
- Two layers of data structures.

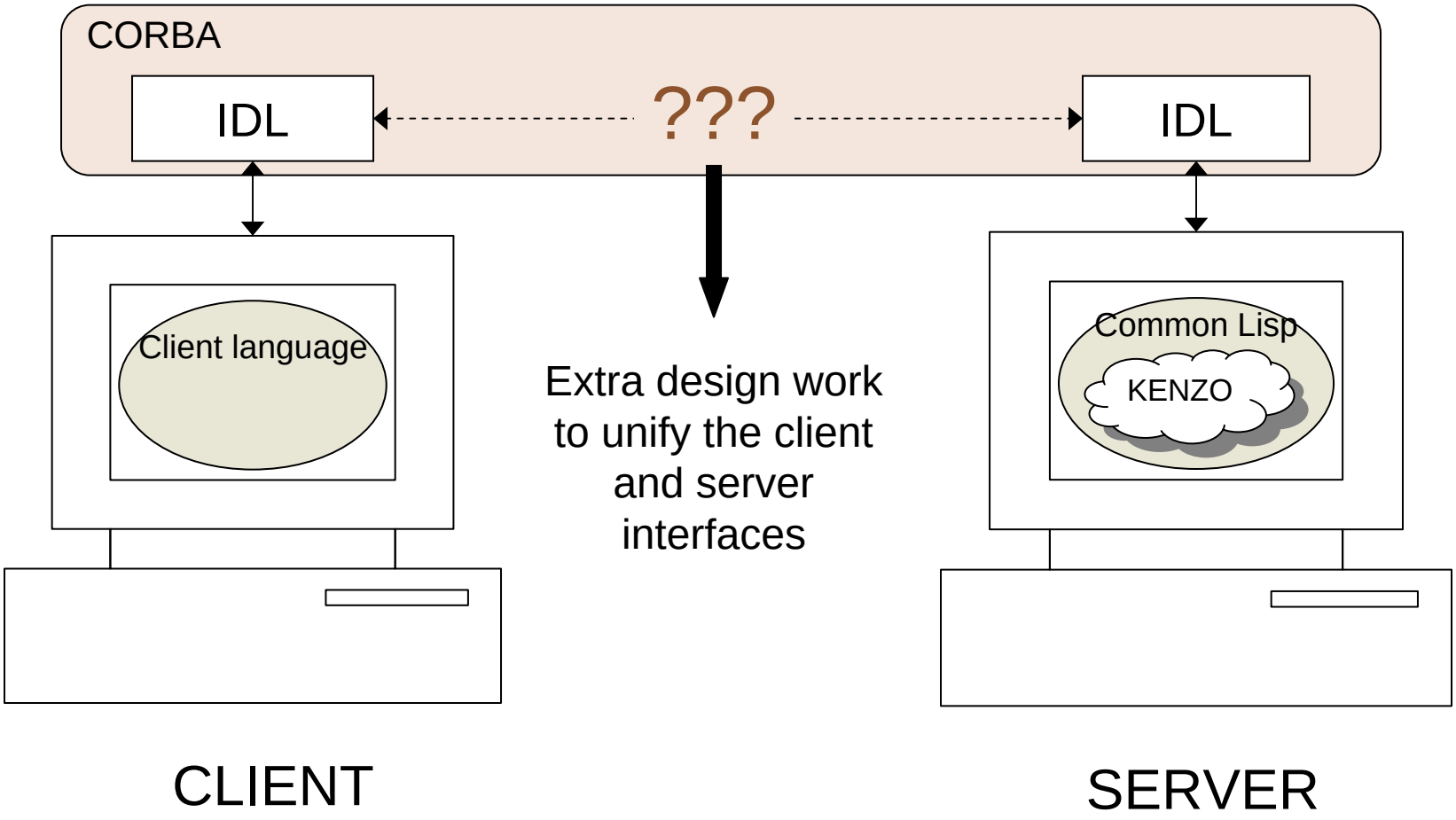
First attempts, first problems

1) Use of XML



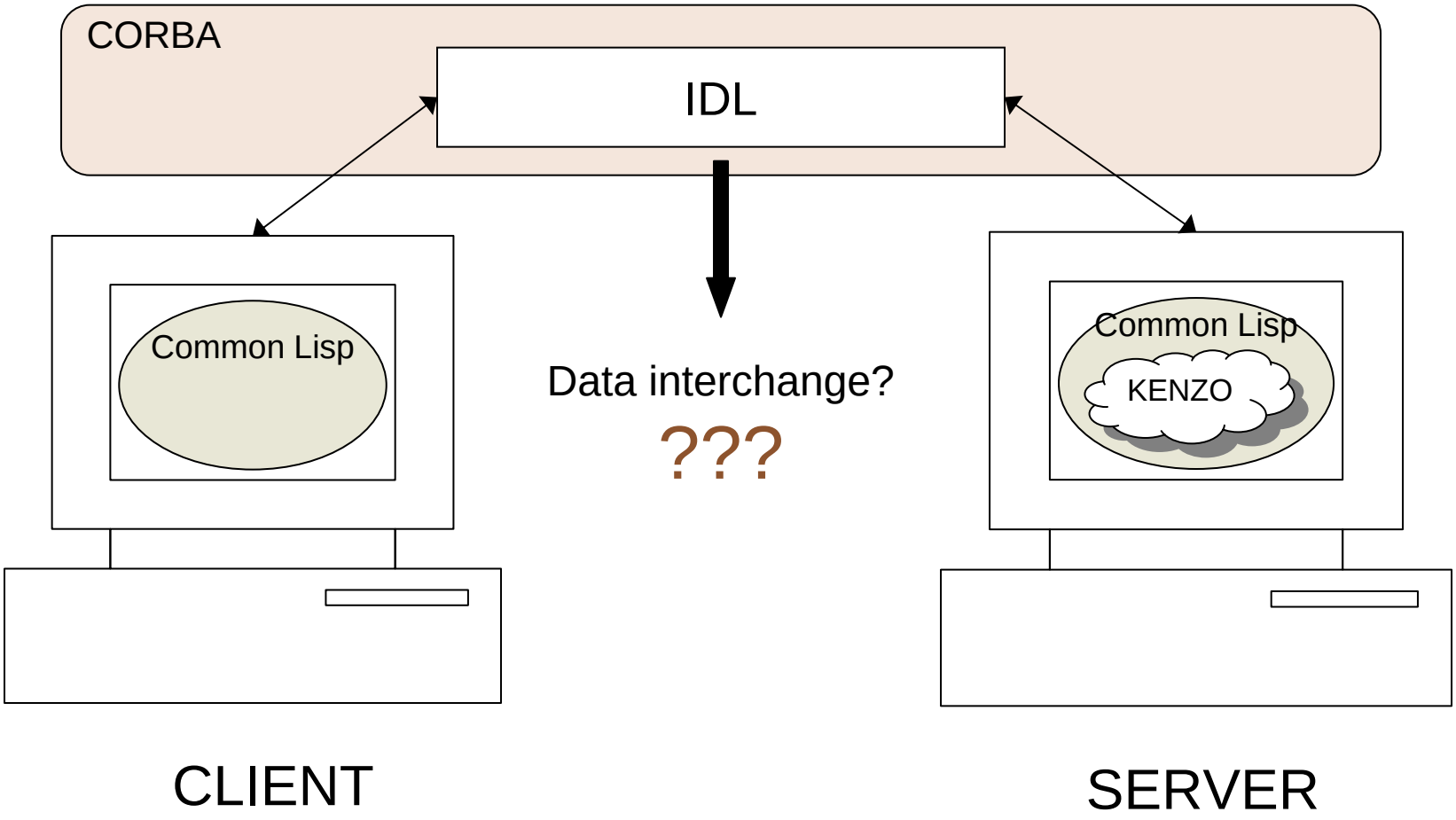
First attempts, first problems

2) CORBA (an object-based middleware)



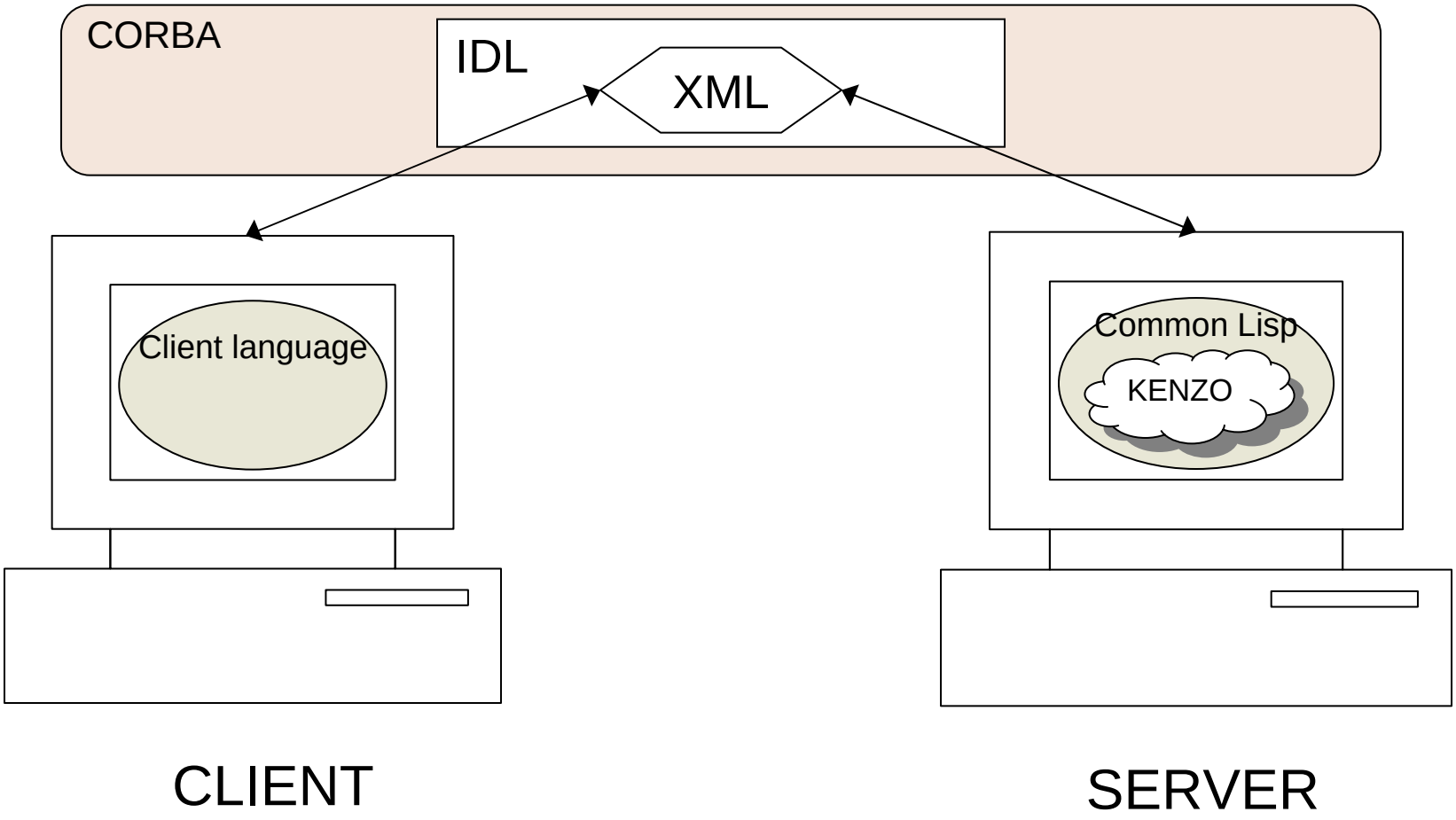
First attempts, first problems

3) CORBA in an homogeneous environment

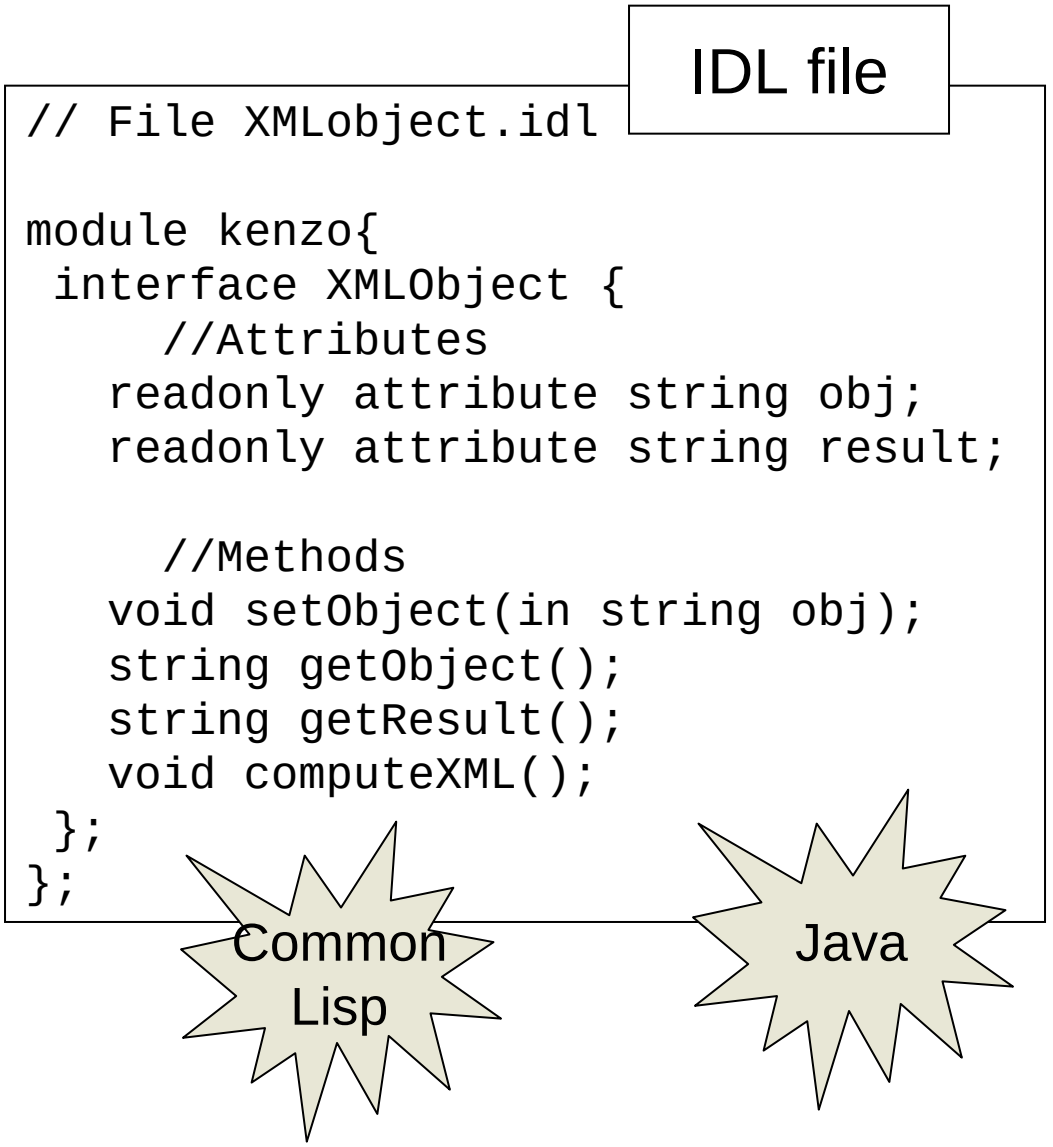


Our solution: XML + CORBA

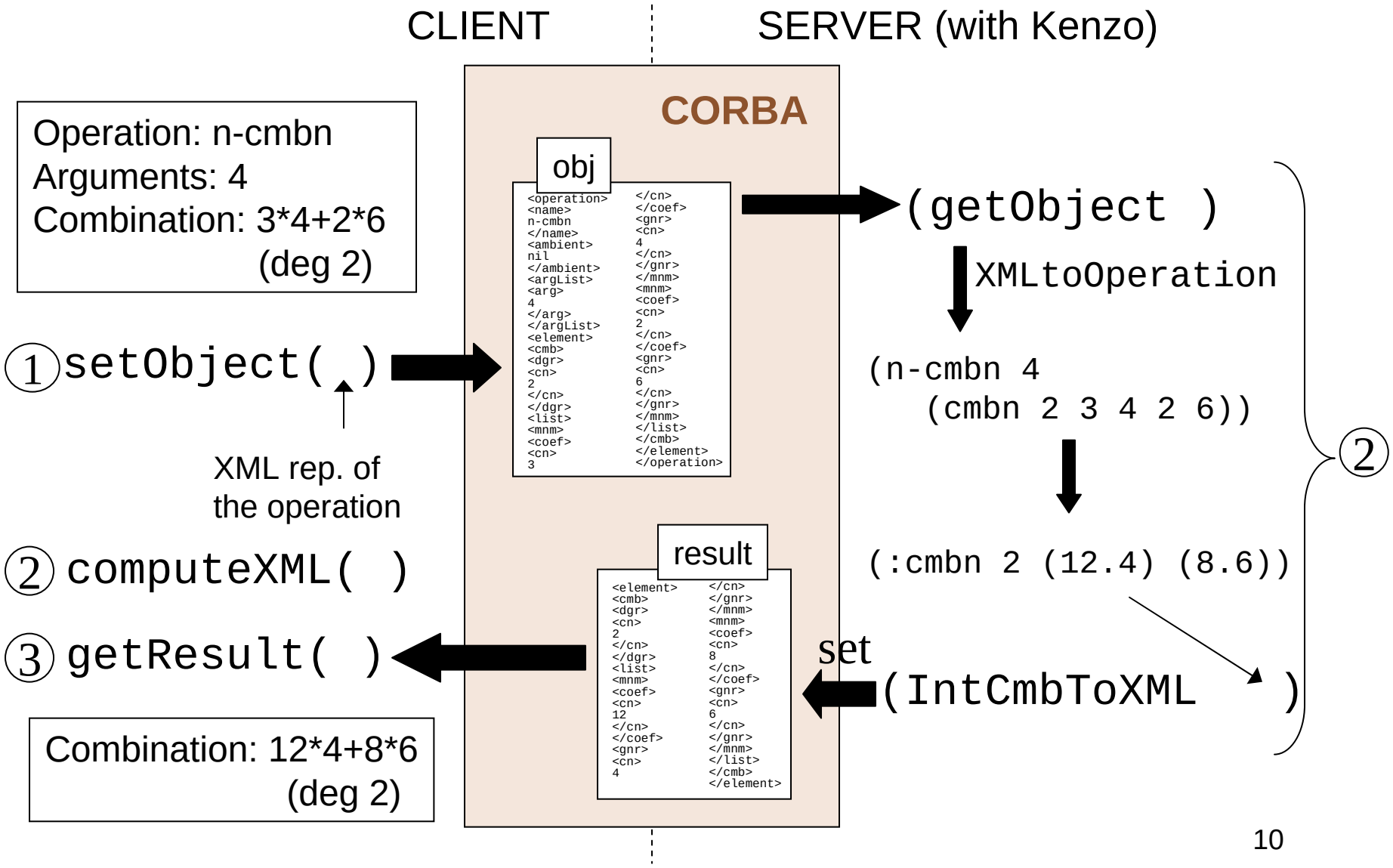
XML as the necessary “glue” to solve the problem of data interchange.



Our solution: XML + CORBA



XML + CORBA: example



XML-based interchange format

Elements (data)

```
<element>
<cmb>
<dgr>
<cn>
2
</cn>
</dgr>
<list>
<mnm>
<coef>
<cn>
12
</cn>
</coef>
<gnr>
<cn>
4
</cn>
<cn>
8
</cn>
</coef>
<gnr>
<cn>
6
</cn>
</gnr>
</mnm>
</list>
</cmb>
</element>
```

Combination 12*4+8*6
(deg 2)

Operations

```
<operation>
<name>
n-cmbn
</name>
<ambient>
nil
</ambient>
<argList>
<arg>
4
</arg>
</argList>
<element>
<cmb>
<dgr>
<cn>
2
</cn>
</dgr>
<list>
<mnm>
<coef>
<cn>
3
</cn>
</coef>
<gnr>
<cn>
4
</cn>
</gnr>
</mnm>
<mnm>
<coef>
<cn>
2
</cn>
</coef>
<gnr>
<cn>
6
</cn>
</gnr>
</mnm>
</list>
</cmb>
</element>
</operation>
```

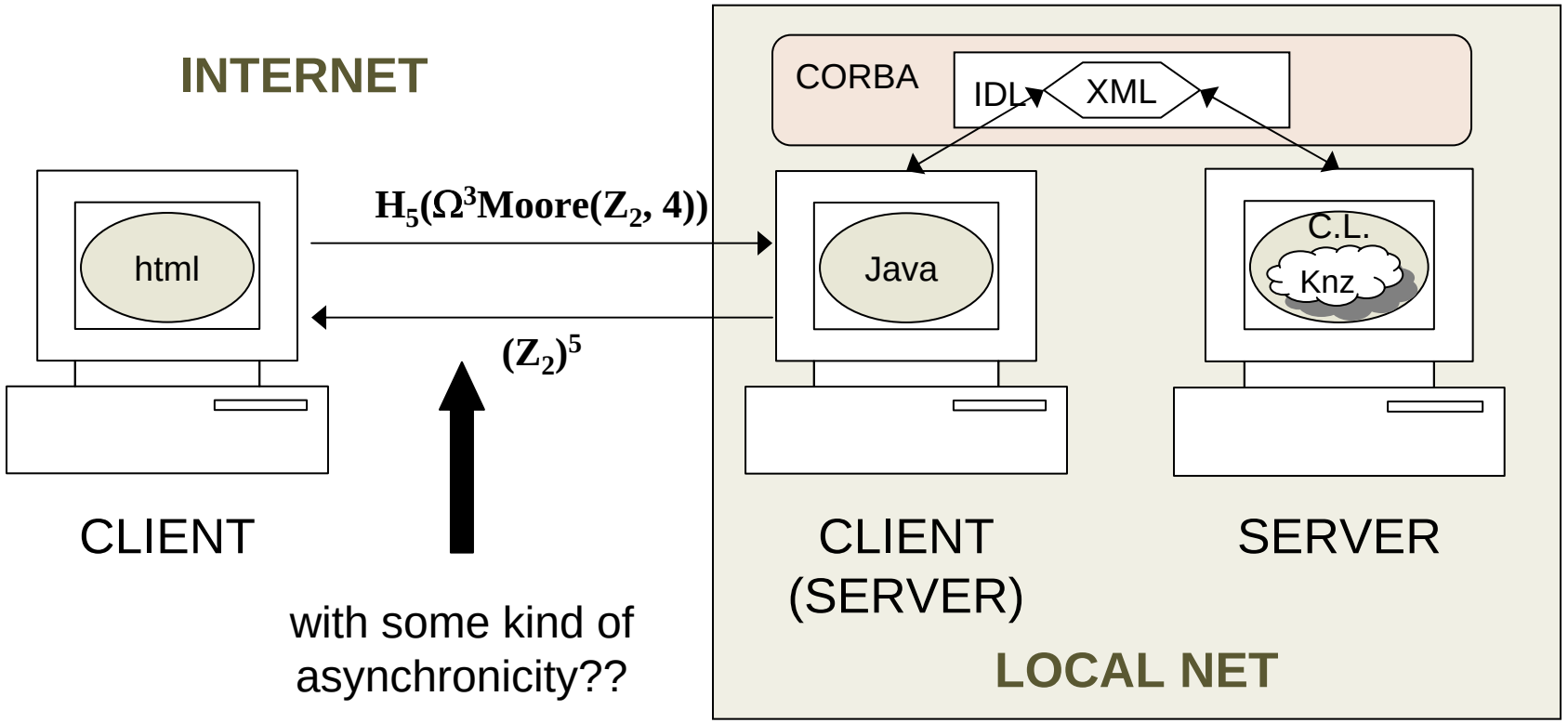
Operation: n-cmbn
Arguments: 4
Combination: 3*4+2*6 (deg 2)

Conclusions

- From local interoperability with XML to client-server XML-interoperability in a local net (reusing the software previously created).
- The XML format that allows the interchange is a proper extension of MathML.
- (Corba-based) Remote access in a local net (not really distributed computing).

Further work (short term)

Next goal: extension to the Internet



Towards Web Services

Further work (long term)

Real distributed computing: several servers cooperating in the same calculation.