A Comparison of Java RMI, CORBA, and Web Services Technologies for Distributed SIP Applications

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Motivation & Research Goals

- To promote more rapid development of more easily-maintained SIP (Signal and Image Processing) software applications through the use of middleware standards.
- To make effective use of legacy code and existing applications whenever possible.
- To make use of established network protocols to ease the burden on programmers and to facilitate code re-use.
- To make use of emerging discovery and service-oriented paradigms for distributed computing applications.
- To compare and contrast current and emerging middleware technologies for distributed computing SIP applications.

Middleware Technologies

- Early distributed computing models focused on a model of remote procedure calls.
- Current focus is on ‘remote objects’ and their use.
- Emerging web services are built on ‘messaging’ concepts, which frequently take the form of request/response method calls on remote objects.
- The technologies establish well-defined protocols for communication between computing elements.
- Depending on technology, language-independence and platform-independence are available.
- Many middleware technologies provide ‘discovery’ for use in defining and providing services.
- Our current focus: Java RMI, CORBA, Web Services (SOAP/XML)

Java RMI (Remote Method Invocation)

- A server object (an instance of a class) exposes one or more interfaces to potential clients.
- Server object registers itself with a simple form of discovery service to provide access to its services.
- Language-specific, in that interfaces are written in Java.
- Platform independent as a result of Java’s platform independence.
- Provides programmer-transparent conversion of method calls to remote method calls.
- Supports both JRMP and IIOP (from CORBA) as ‘wire-protocols’ for method calls.
- Any platform that interacts with or supports Java can take advantage of this technology (*e.g.,* Matlab).

CORBA

Common Object Request Broker Architecture

- Language independent, in that a variety of programming languages are supported.
- Exposed service interfaces are described in language-neutral IDL.
- Well-suited for integration with legacy code and applications.
- Communicates using standardized IIOP (Internet Inter-Orb Protocol).

Web Services

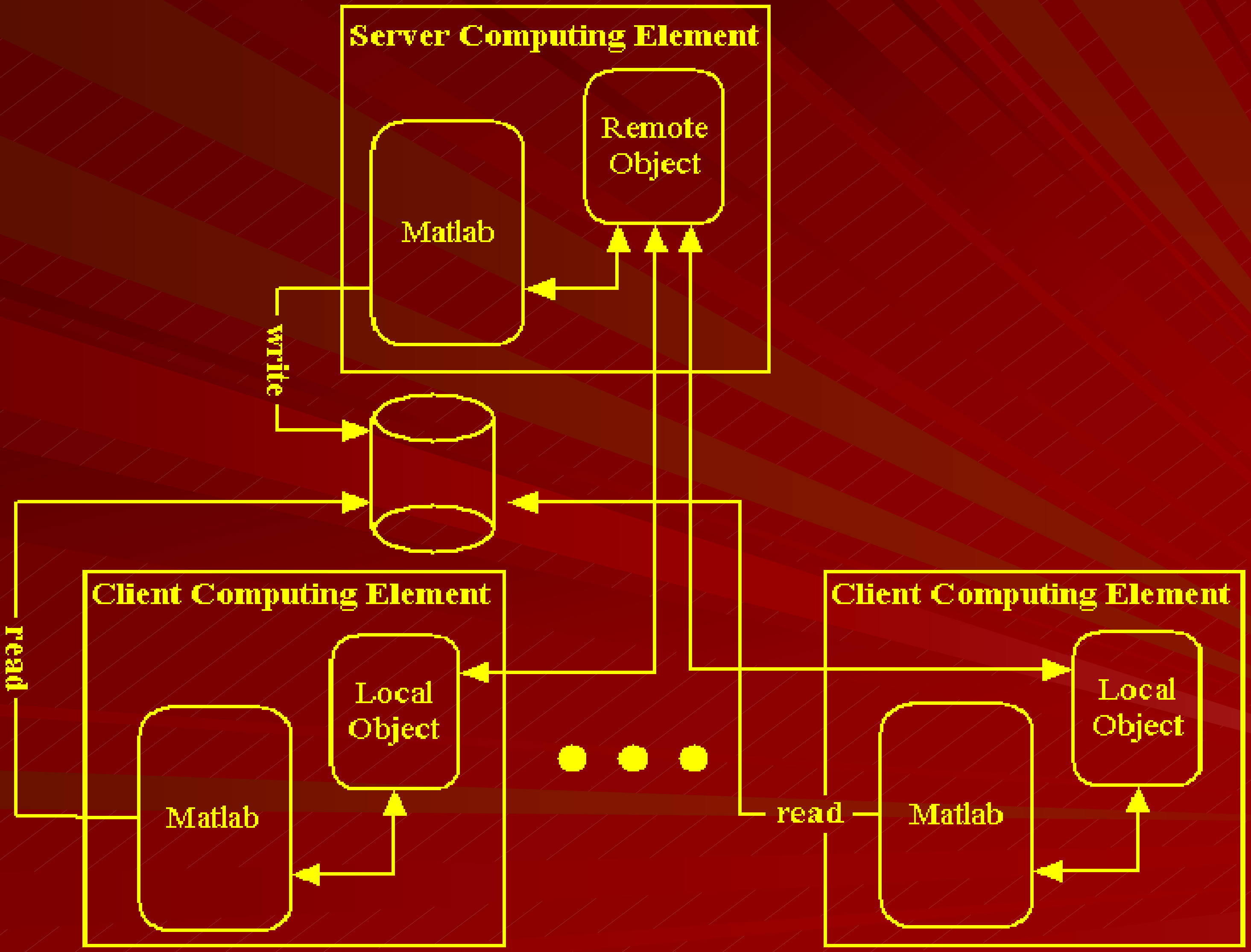
SOAP/XML

- SOAP protocol (XML-based) used to describe messages passed across a network.
- Messages carried on a network protocol such as HTTP, HTTPS, SMTP, *et al*.
- Interfaces are language independent, in much the same way as CORBA. Interfaces are described in WSDL.

Example: Clustering Algorithm

- Goal: Find a specific number of cluster centers in a supplied data set.
- Distributed algorithm written in Matlab.
- Inputs:
  - Data set:
    - *M* – dimension of each data point
    - *N* – Number of data points
  - Centers:
    - *c* – Number of centers to locate in data set
  - Computing elements:
    - *L* – Number of available computing elements
- Outputs:
  - The *c* located cluster centers, each of which is dimension *M*.

An RMI Client-Server Architecture for Distributed Matlab Applications



RMI Architecture Communications

- Server Matlab process initializes Java server-object and exports interfaces to the internet.
- Server Matlab process initiates client startup, providing instructions for contacting remote server object through a common file system.
- Server Matlab process allocates data to each client and exports relevant data to the server object.
- Server Matlab process alerts clients, through the remote object, that data is ready.
- Server Matlab process, meanwhile, waits for client processes to complete task.
- Client Matlab processes retrieve data, process, and report results back to server remote object.
- Client Matlab processes await instructions to terminate or process more data.
- Server Matlab process collects data, analyzes, and then repeats or finishes. Server notifies clients, through server object, of decision.

Future Work & References

- Implement CORBA and SOAP/XML architecture for Matlab-oriented, distributed SIP applications.
- Conduct performance comparisons of middleware technologies.
- Generalize framework for distributed SIP applications.

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