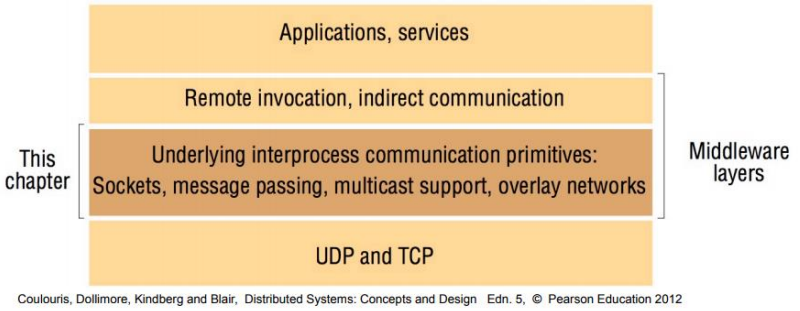
FIT3142 Tutorial #2

Inter-Process Communications

2.1 Question 1 (25%)

Explain the basic differences between a stream oriented IPC scheme and a Remote Procedure Call (RPC) scheme.



Coulouris, Dollimore, Kindberg and Blair, Distributed Systems: Concepts and Design Edn. 5, © Pearson Education 2012

- **The "middleware" provides the API interface for the user program running in a process;**
- **The middleware interfaces to the protocol stack software, which is usually embedded in the operating system kernel;**

- Stream oriented network API interfaces provide an unstructured channel for byte or message oriented data transfers, which carry data – this is the most basic abstraction possible, involving read() and write() calls;
- The next level of abstraction is that of a remote procedure call in which a procedure (i.e. function call) may be executed locally on a host, or on a remote server host; • The client process will make a request upon a server process, which involves a procedure identifier (name) and some list of arguments; the server then returns the results of the call;
- This is a structured API that bounds the transfers to very specific messages – calls and returns of values;
- ONC RPC (RFC1831) protocol is the most widely used remote procedure call API;

(b) Remote Procedure Calls

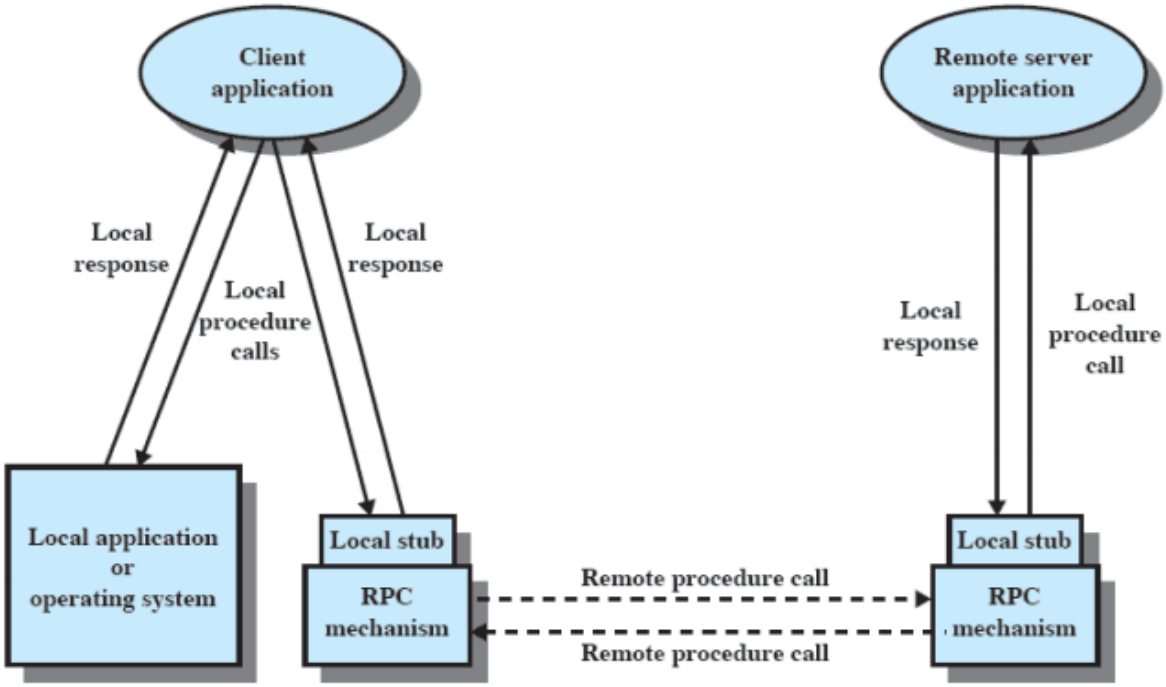


Figure 16.12 Remote Procedure Call Mechanism

2.2 Question 2 (25%)

Explain the basic differences between a Remote Procedure Call (RPC) scheme, and a Remote Object Invocation scheme.

- Stream oriented network API interfaces provide an unstructured channel for byte or message oriented data transfers, which carry data – this is the most basic abstraction possible, involving read() and write() calls;
- The next level of abstraction is that of a remote procedure call in which a procedure (i.e. function call) may be executed locally on a host, or on a remote server host; • The client process will make a request upon a server process, which involves a procedure identifier (name) and some list of arguments; the server then returns the results of the call;
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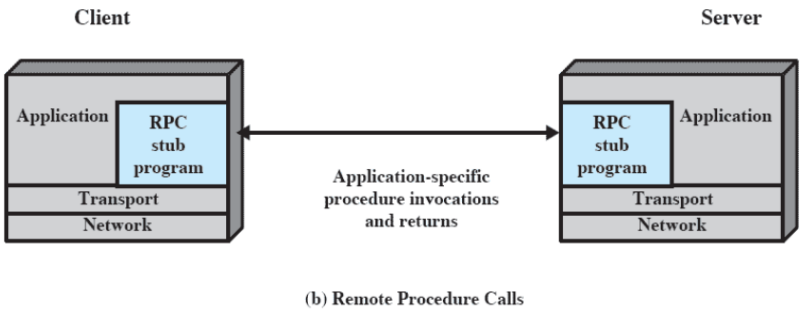

(b) Remote Procedure Calls

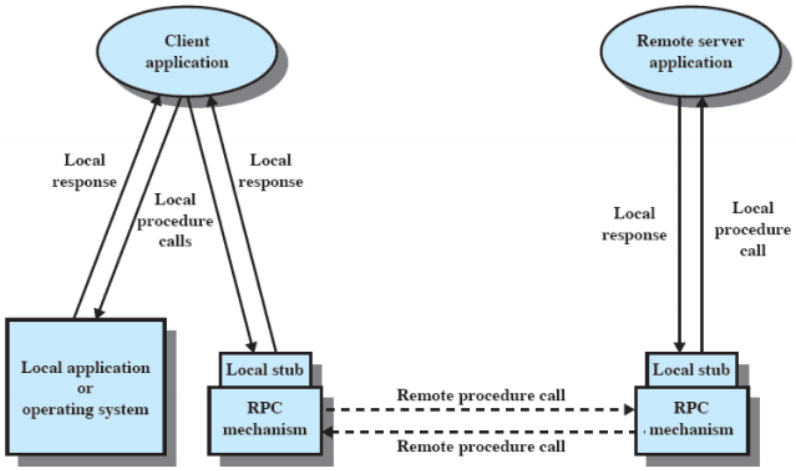

Figure 16.12 Remote Procedure Call Mechanism

- The socket IPC API provides for unstructured transfers of data, while remote procedure call APIs are designed for remote execution of subroutine code;
- Neither of these abstractions is well aligned with Object Oriented (OO) languages, such as C++, C#, Objective C, Java, Python, where objects combine internal procedures and data;
- The preferred approach has been to develop OO APIs for such languages, using protocols that support the remote invocation and management of objects;
- The general approach used in such APIs follows a similar model to that used with remote procedure calls;
- A number of schemes have been developed since the 1990s to provide this style of API, support depending on the language and operating system employed;

Some Remote Object Invocation Schemes

- The popularity of OO languages resulted in ~30 schemes for remote object invocation, the most widely used are:
- CORBA (Common Object Request Broker Architecture) was developed for the C++ language and Unix operating system, even though other languages and platforms are supported;
- Windows Communication Foundation (WCF) evolved from DCOM (Distributed Component Object Model), developed by Microsoft to compete with CORBA, using DCE/RPC;
- Java Remote Method Invocation (Java RMI) running over Java Remote Method Protocol (JRMP) is Java specific scheme;
- SOAP (Simple Object Access Protocol) evolved from the earlier XML-RPC scheme and uses XML encoded messages usually over HTTP transport; SOAP is used for web services and also in the Open GRID protocol suite;

2.3 Question 3 (25%)

What category do Web Services fall into, and why?

Web Services - Simple Object Access Protocol

- Communications between distributed applications in WS employ primarily HTTP, or other “basic” well established protocols such as FTP, SMTP etc;
- Messaging is based on SOAP (Simple Object Access Protocol), which is most commonly transmitted over HTTP or HTTPS in secure environments;
- SOAP provides similar functionality to CORBA, but is inherently more verbose due to the use of XML;
- W3C: “A SOAP message is fundamentally a one-way transmission between SOAP nodes, from a SOAP sender to a SOAP receiver, but SOAP messages are expected to be combined by applications to implement more complex interaction patterns ranging from request/response to multiple, back-and-forth ‘conversational’ exchanges.”

- HTTP (Hypertext Transfer Protocol) is the most widely used protocol on the W3 and is a good example of a protocol built on top of the BSD Socket API;
- When a browser (client) intends to make a request of a web server (server), it opens a socket connection over the Internet to the web server;
- The browser then sends a HTTP Method message to the web server, for instance: GET /mypath/to/myfile/blogs.html HTTP/1.0
- The socket connection is then closed, while the server processes the method request;
- Once processing is complete, the web server opens a socket connection to the client, and responds with a message, header and MIME encoded body: HTTP/1.0 404 Not Found

…….

- Once the Body is transferred, the socket connection is then closed;
- HTTP is widely used to support other mechanisms used in distributed computing;
- Secure HTTP (SHTTP) employs a more complex connection mechanism due to the use of TLS or SSL encryption layers;
- As HTTP lacks mechanisms to handle multiple servers concurrently, it is a good example of a basic client server protocol.

2.4 Question 4 (25%)

Compare the abstractions used and language APIs employed for stream oriented IPC schemes, RPC schemes, Remote Object Invocation schemes, and Web Services.