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Unit-III

Remote Procedure Calls

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Introduction

As IPC protocol is designed for one distribute application and does not provide a foundation on which to built a variety of distributed applications. Therefore, a need was felt for a general IPC protocol that can be used for designing several distributed applications. The Remote Procedure Call (RPC) facility emerged out of this need.IPC gained popularity because of following reasons;

1. Simple Call Syntax.
2. Familiar Semantics.
3. Its specification of a well-defined interface.
4. Its ease of use.
5. Its generality.
6. Its efficiency.
7. It can be used as an IPC mechanism to communicate between processes on different machines as well as between different processes on the same machine.

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RPC Model

The RPC model is similar to the well-known and well-understood procedure call model used for the transfer of control and data within a program in the following manner;

1. To make a procedure call
2. Control transfer
3. Procedure body execution
4. Returning control

The RPC mechanism is an extension of the procedure call mechanism in the sense that it enables a call to be made to a procedure that does not reside in the address space of the calling process. The called procedure(commonly called remote procedure) may be on the same computer or on the different computer.

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RPC Model...[Contd..]

Therefore the mecahnism of RPC is;

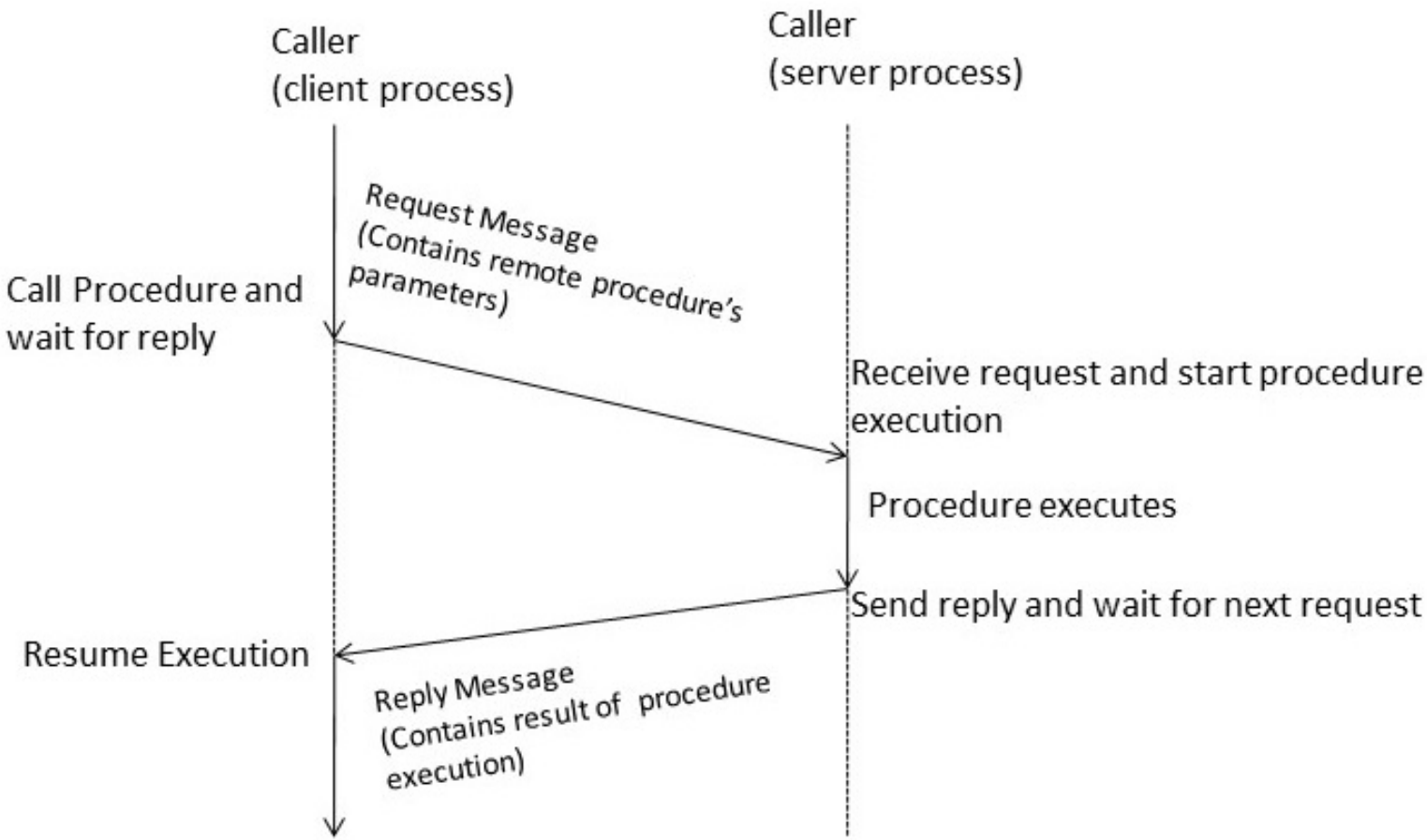

Figure: RPC Model

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Transparency of RPC

A transparent RPC mechanism is one in which local procedures and remote procedures indistinguishable to the programmers. This requires the following two types of transparencies

- Syntactic Transparency
- Semantic Transparency

- Syntactic transparency are easy
- Semantic Transparency are not easy

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Implementation of RPC

Implementation of RPC mechanism usually involves the following five elements of program.

1. Client
2. Client Stub
3. RPC Run time
4. Server Stub
5. Server

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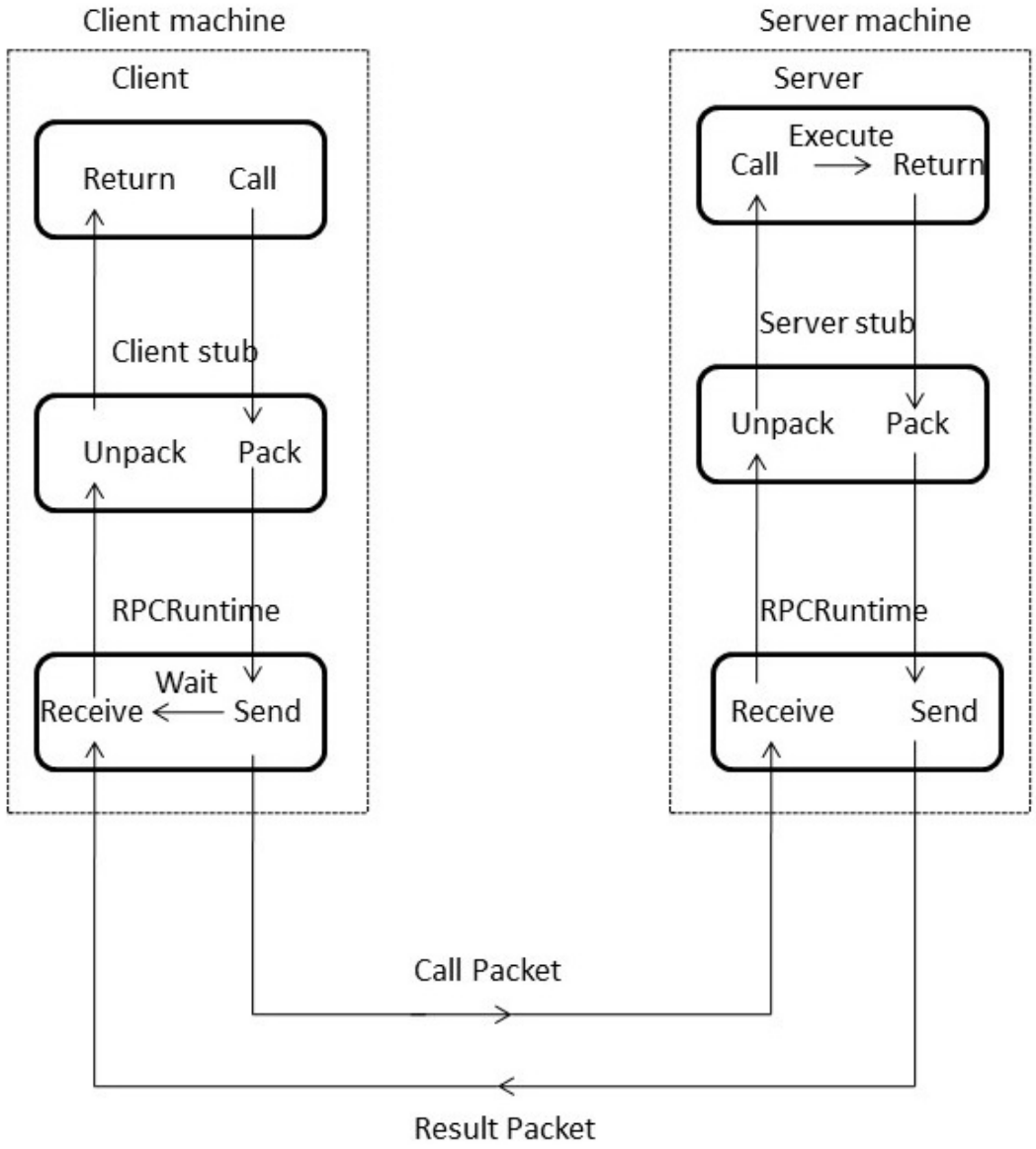
Implementation of RPC...[Cntd..]



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Stub Generation

Stub can be generated in one of the following ways.

- Manually
- Automatically

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RPC Messages

There are two types of messages involved in RPC implementation.

1. Call Messages
2. Reply Messages

1. Call Message

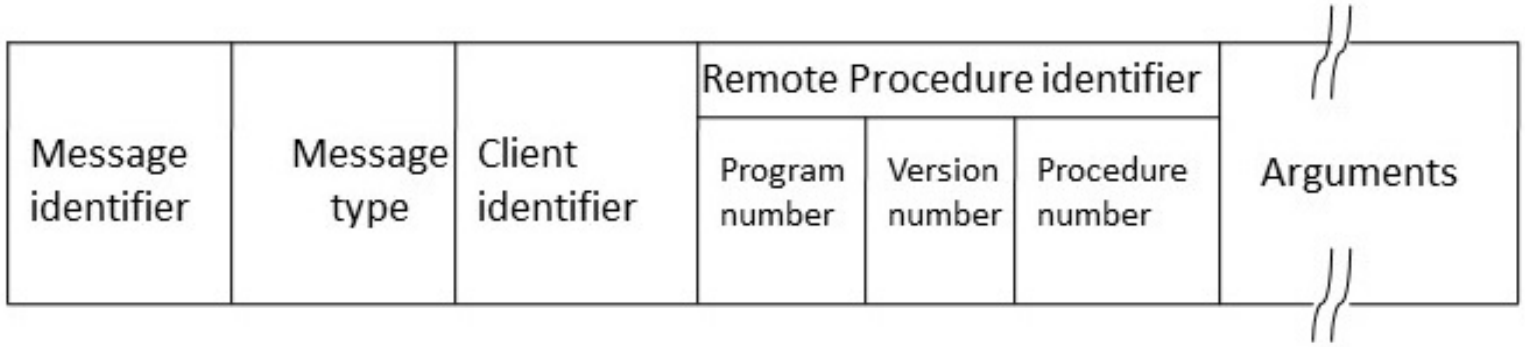

Figure: RPC Call Message Format

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RPC Messages...[Cntd...]

2. Reply Message

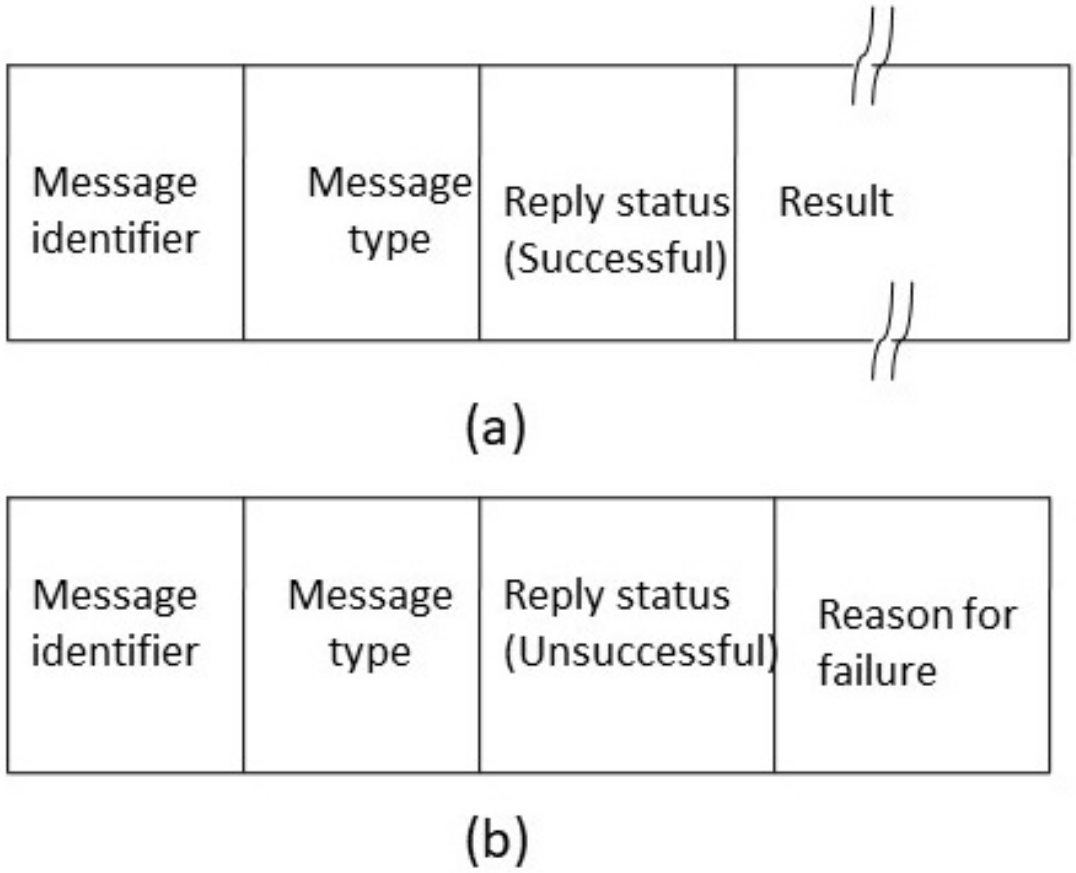

Figure: (a)A Successfule Reply Message Format (b)An Unsuccessful Message Format

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Marshaling Arguments and Results

For RPC, encoding and decoding of message data is called Marshaling and involves following actions.

1. Taking the arguments
2. Encoding the message data
3. Decoding the message data

Marshaling procedure may be classified into two groups

- Those provided as a part of the RPC software
- Those that are defined by the user of the RPC system.

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Server Management

In IPC-based applications, two important issues that need to be considered for server management;

1. Server Implementation
2. Server Creation

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Server Management...[Cntd..]

1. Server Implementation

Based on the style of implementation used, servers may be of two types

- Stateful Servers
- Stateless Servers

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Server Management...[Cntd..]

1.1 Stateful Server

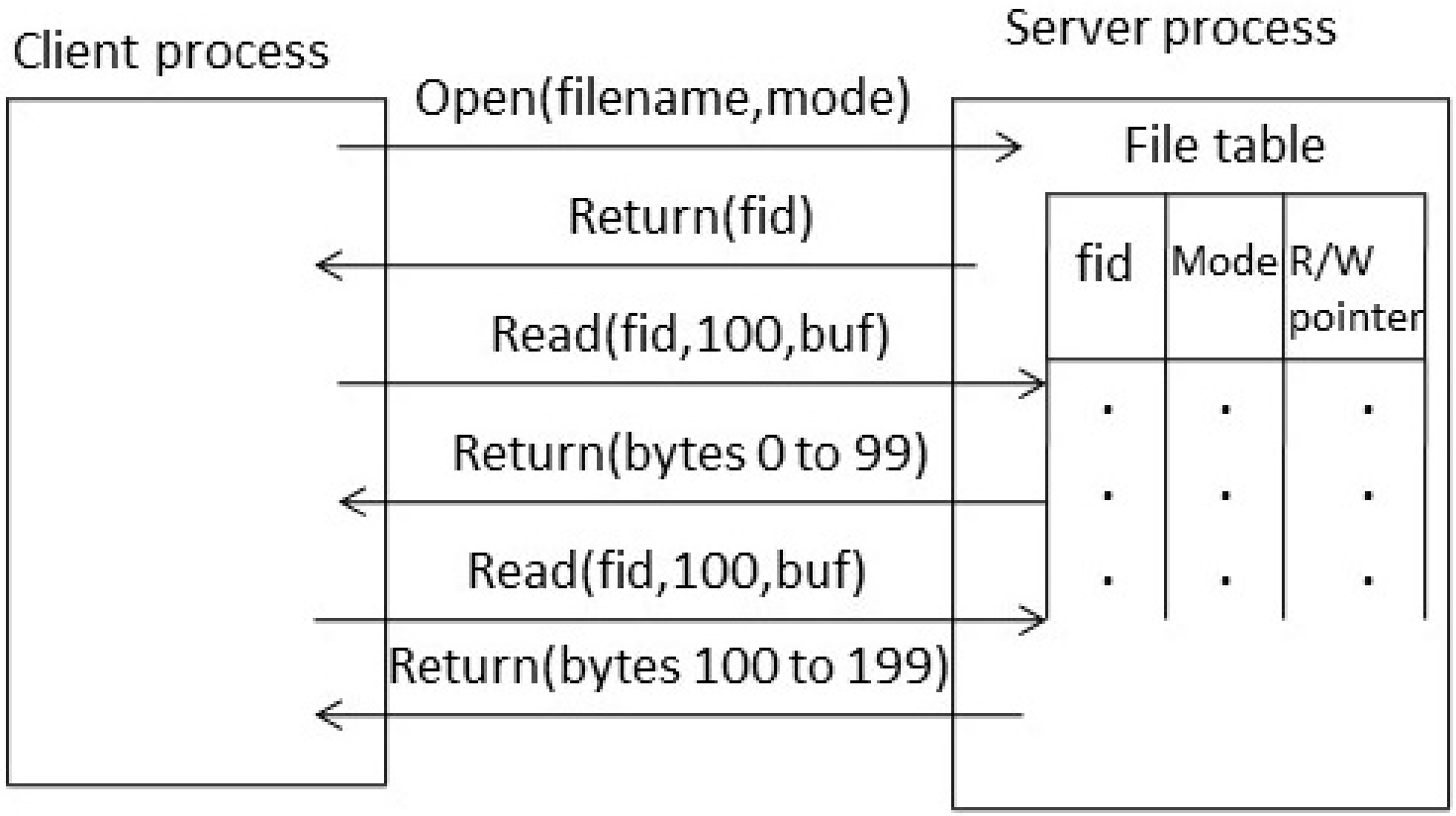

Figure: Example of a Stateful File Server

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Server Management...[Cntd..]

1.2 Stateless Servers

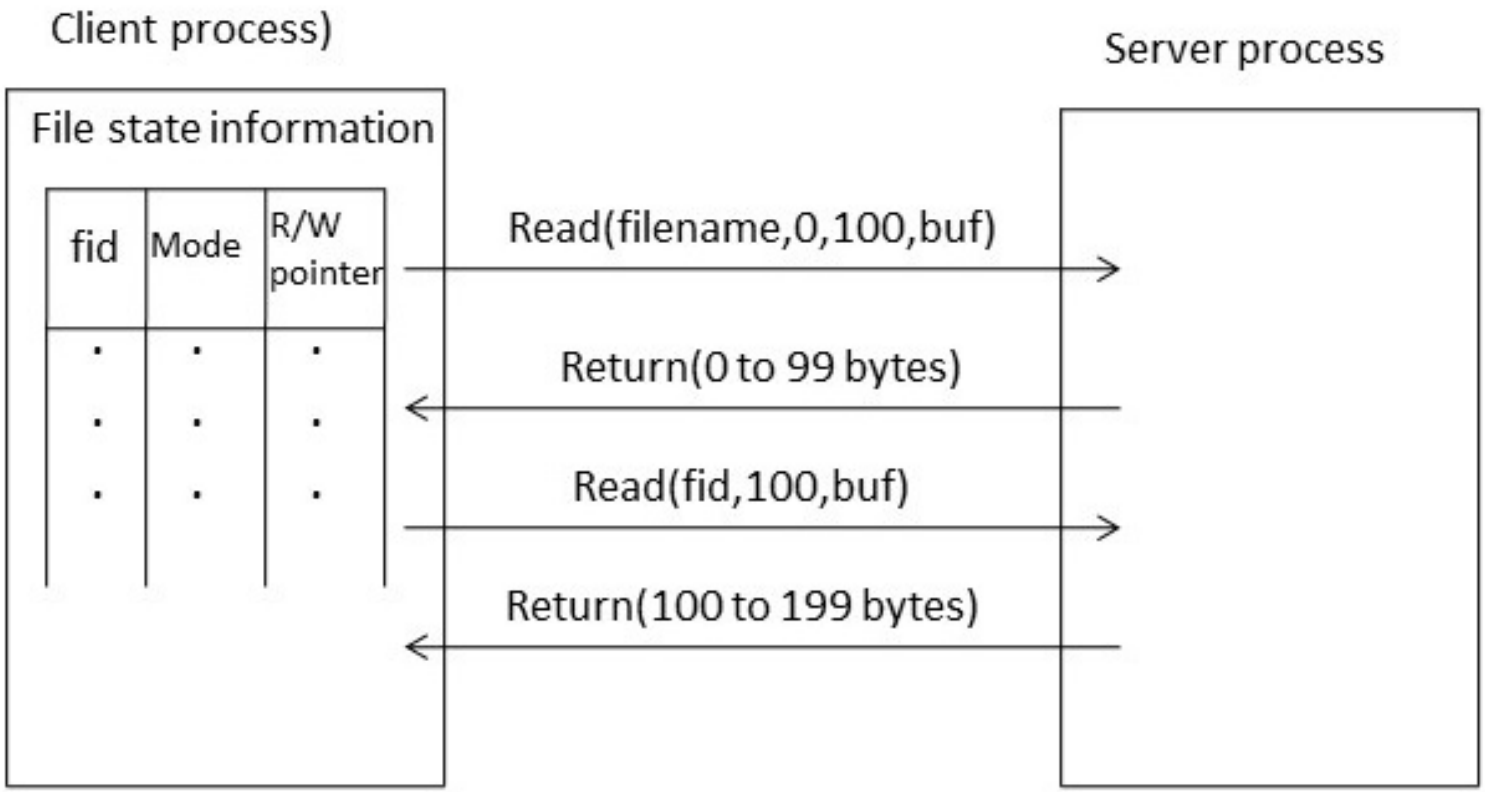

Figure: Example of a Stateless File Server

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Server Management...[Cntd..]

2. Server Creation Semantics

Based on the time duration for which RPC server survive, they may be classified as;

- Instance-per-Call Servers
- Instance-per-Session Servers
- Persistent Servers

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Parameter-Passing Semantics

The choice of parameter-Passing semantics is a crucial to the design of an RPC mechanism. Followings are the choices of parameter passing;

- Call-by-Value
- Call-by-Reference

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Call Semantics

In RPC,the caller and callee processes are possibly located on different nodes. Thus it is possible for eithe the caller or callee node to fail independently and later to be restarted. In addition, failure of communication links are also possible, therefore , the normal functioning of an RPC may gets disrupted due to following reason;

1. The call message gets lost
2. Response message gets lost
3. The callee node crashes and is restarted
4. The caller node crashes and is restarted

The different types of call semantics used in RPC system are;

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Call Semantics..[Cntd...]

The different types of call semantics used in RPC system are;

1. Possibly or May-be Call Semantics
2. Last-one Call Semantics
3. Last-of-Many Call Semantics
4. At-Least-Once Call Semantics
5. Exactly-Once Call Semantics

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Communication Protocols for RPC's

Based on the needs of different systems, several communication protocols have been proposed for use of RPC's. Followings are the protocols;

1. The Request Protocol
2. The Request/Reply Protocol
3. The Request/Reply/Acknowledge-Reply Protocol

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Communication Protocols for RPC's...[Cnts...]

1. The Request Protocol

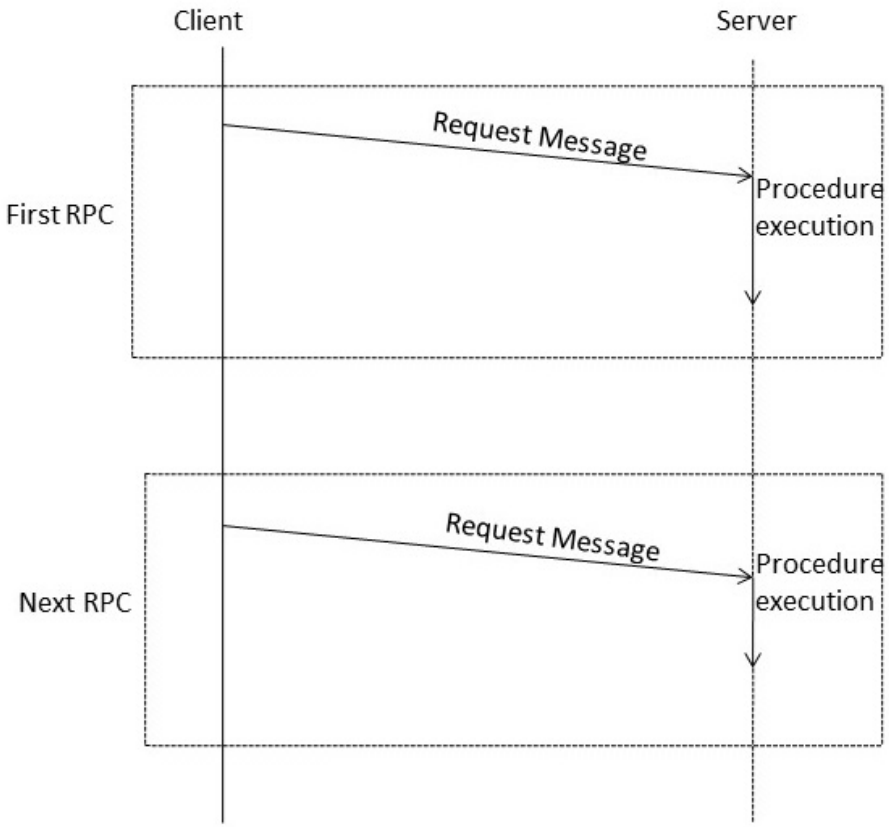

Figure: Request(R) Protocol

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Communication Protocols for RPC's...[Cnts...]

2. The Request/Reply Protocol

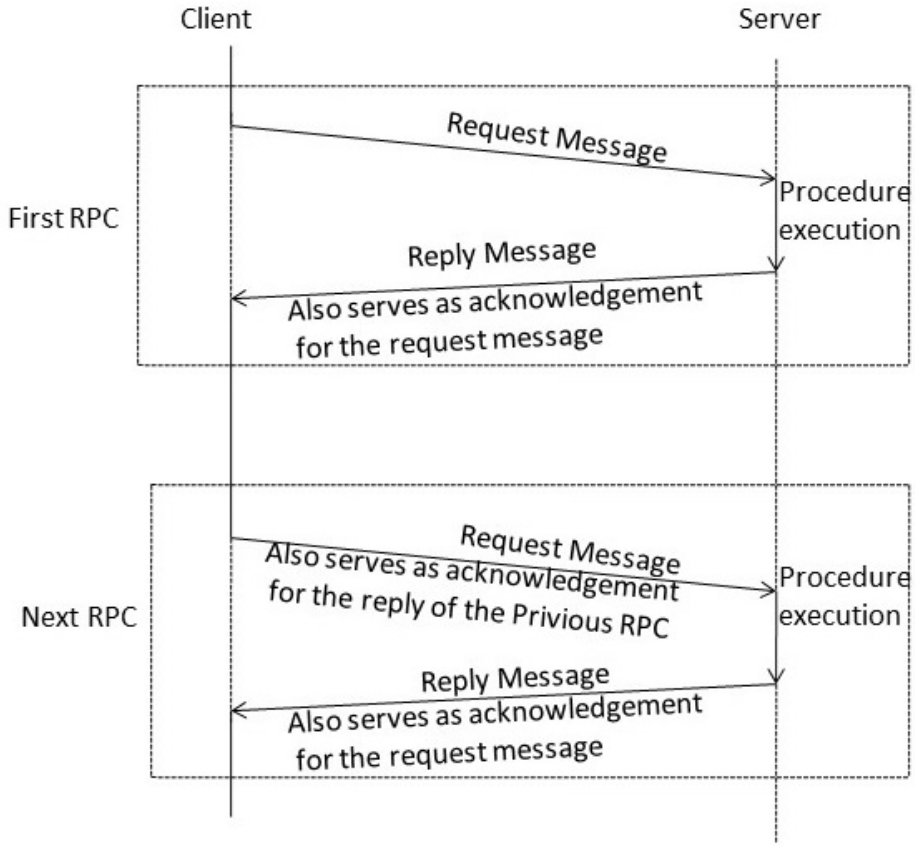

Figure: Request/Reply (RR) Protocol

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Communication Protocols for RPC's...[Cnts...]

3. The Request/Reply/Acknowledge-Reply Protocol

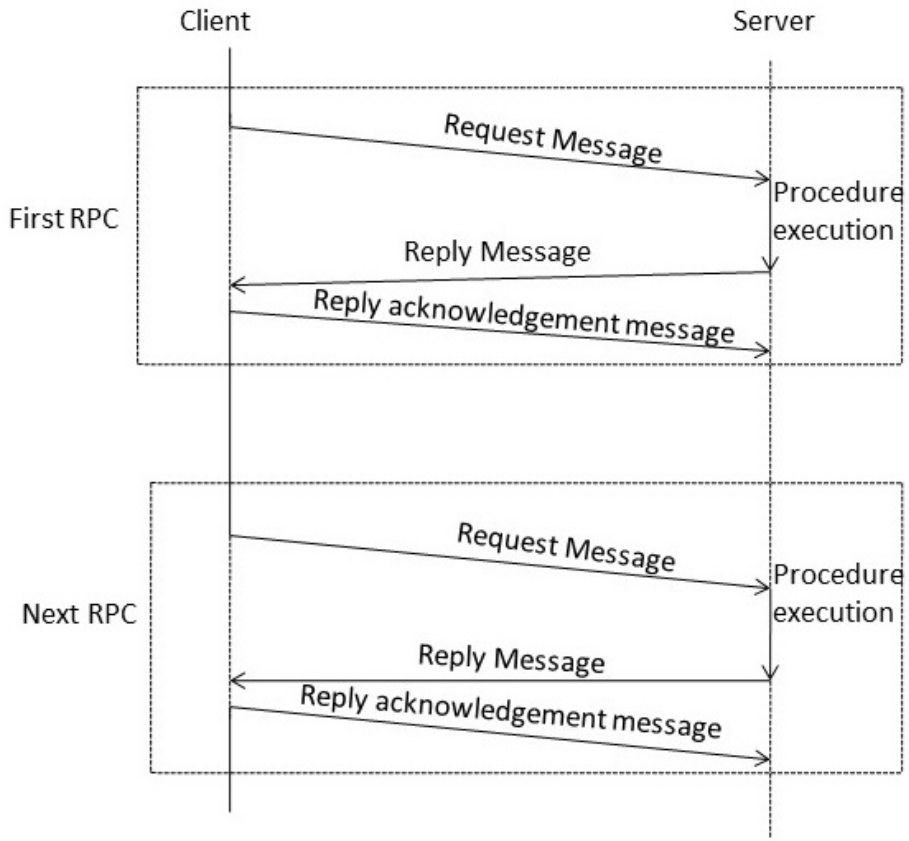

Figure: The Request/Reply/Acknowledge-Reply (RRA) Protocol