Evaluation of XML-RPC interoperability between the .NET and JAVA framework

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Contents

1. Motivation 4
1.1. Scenario 4
1.2. XML-RPC description 4
1.3. XML-RPC implementations 4
1.3.1. Apache XML-RPC 4
1.3.2. XmlRpcCS 5
2. Test setup 5
2.1. Java 5
2.2. .NET 5
3. Test results 6
4. Review of results 7
5. Listings 8
5.1. C# 8
5.1.1. Server 8
5.1.2. Client 9
5.2. JAVA 10
5.2.1. Server 10
5.2.2. Client 11
6. Acknowledgement 12

1. Motivation

Interoperability describes the ability of a system to access functions from another one. As long as the underlying operating system and the software platform are identical, components can chose between various protocols and mechanisms which usually work very efficiently. This evaluation investigates the interoperability of the two major platforms in the IT world: The JAVA platform and the .NET framework[1]. In order to generalize the results a common communication protocol has to be used, which is ideally based on XML. Despite the success of SOAP in web-like application environments, a full-fledged SOAP implementation was not desired for reasons of efficiency. Hence this evaluation uses the more basic but much more efficient XML-RPC to communicate between both platforms.

1.1. Scenario

The target platform of this investigation is a small-sized PC - the OQO[2] - which is used as one of the implementation platforms in a European research project for wearable computing. The wearable platform to be implemented actually relies on implemented components both in JAVA and .NET. In order to reduce the reimplementation and porting effort the interoperability of two co-existing framework parts is deemed necessary to satisfy some project constraints.

1.2. XML-RPC description

XML-RPC is a specification and a set of implementations allowing to make remote procedure calls (RPC) over TCP/IP connections utilizing XML as data format. Typically XML-RPC uses the HTTP protocol to communicate between two communication endpoints. The payload data of an XML-RPC call are the parameters. They can represent scalar values like numbers, strings, etc. up to complex data-structures like records or lists.

Detailed information can be found on: http://www.xmlrpc.com.

1.3. XML-RPC implementations

A number of XML-RPC implementations exist. These libraries are available for all current programming languages like PHP, Python, C/C++, JAVA, C# or Perl. For our scenario we use the XML-RPC versions for .NET, C# and JAVA.

1.3.1. Apache XML-RPC

The Apache XML-RPC implementation is very mature and offers full support for the HTTP protocol if needed. Additionally (which is interesting for local

1 .NET is a trademark of Microsoft Corp. JAVA is a trademark of Sun Microsystems Inc.

2 Http://www.oqo.com

interoperability investigations), it comes with an optimized light-weight client with only basic HTTP support. The server side of XML-RPC is not only supported by embedding XML-RPC into an existing web-server, but also comes with its own internal XML-RPC server.

Apache XML-RPC is under the Apache Software License, Version 2.0.

Link: http://ws.apache.org/xmlrpc/index.html

1.3.2. XmlRpcCS

Like Apache XML-RPC the XmlRpcCS (CS obviously stands for C#) supports both XML-RPC client and server behavior. It is not only fully XML-RPC compliant, but additionally supports the .NET Compact Framework and the open-source .NET counterpart Mono.

XmlRpcCS is under the BSD license.

Link: http://xmlrpccs.sourceforge.net/

2. Test setup

The interoperability tests took place on a machine running a .NET or JAVA client vs. a corresponding server. The development hardware as a standard desktop PC (3 Ghz, Intel P4 HT, 1 GB RAM) and the OQO – a Transmeta based shrink-sized PC with 1GHz CPU and 265 MB RAM. The operating system used was Windows XP Professional. The following environment was used for the test:

2.1. Java

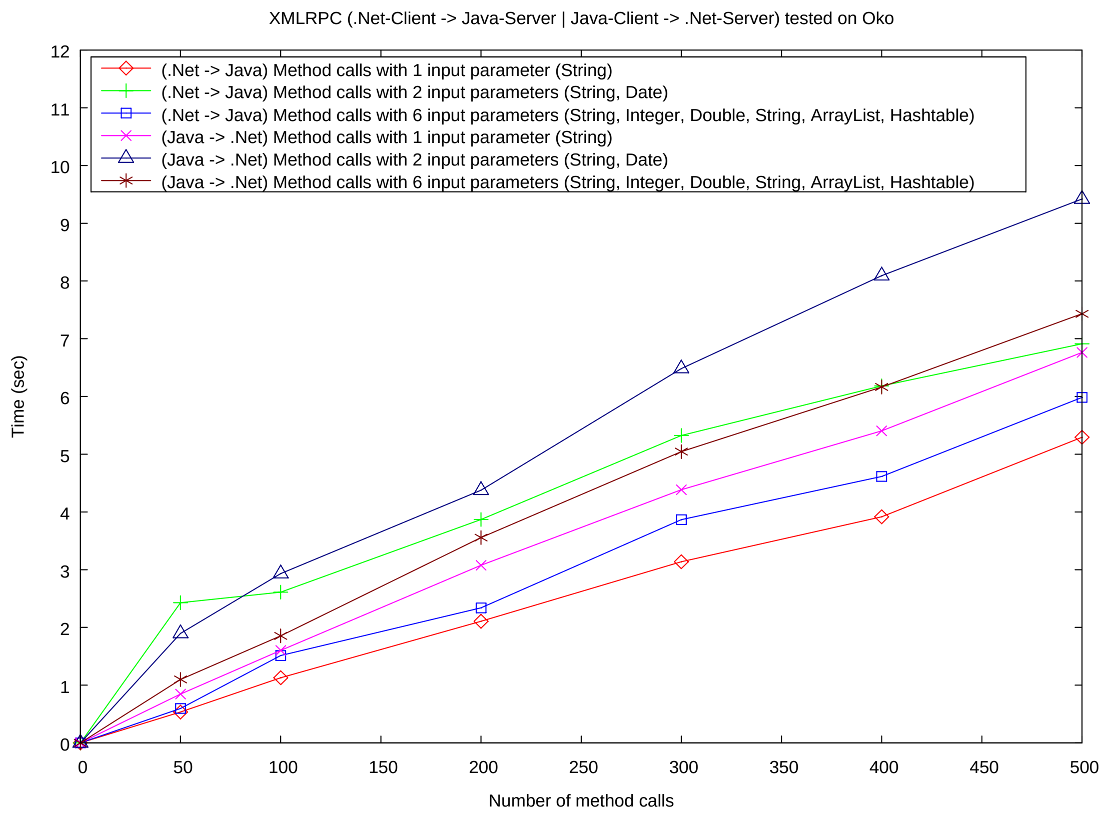
- Java(TM) 2 Runtime Environment, Standard Edition (build 1.4.2_05-b04) (development PC)
- JAVA(TM) 2 Runtime Environment, Standard Edition (build 1.5.0) (OQO)
- Apache XML-RPC Version 2.0.1 + Apache Commons Codec Version 1.3 (required by XML-RPC for encode/decode XML streams)
- Used development environment: Eclipse 3.1

2.2. .NET

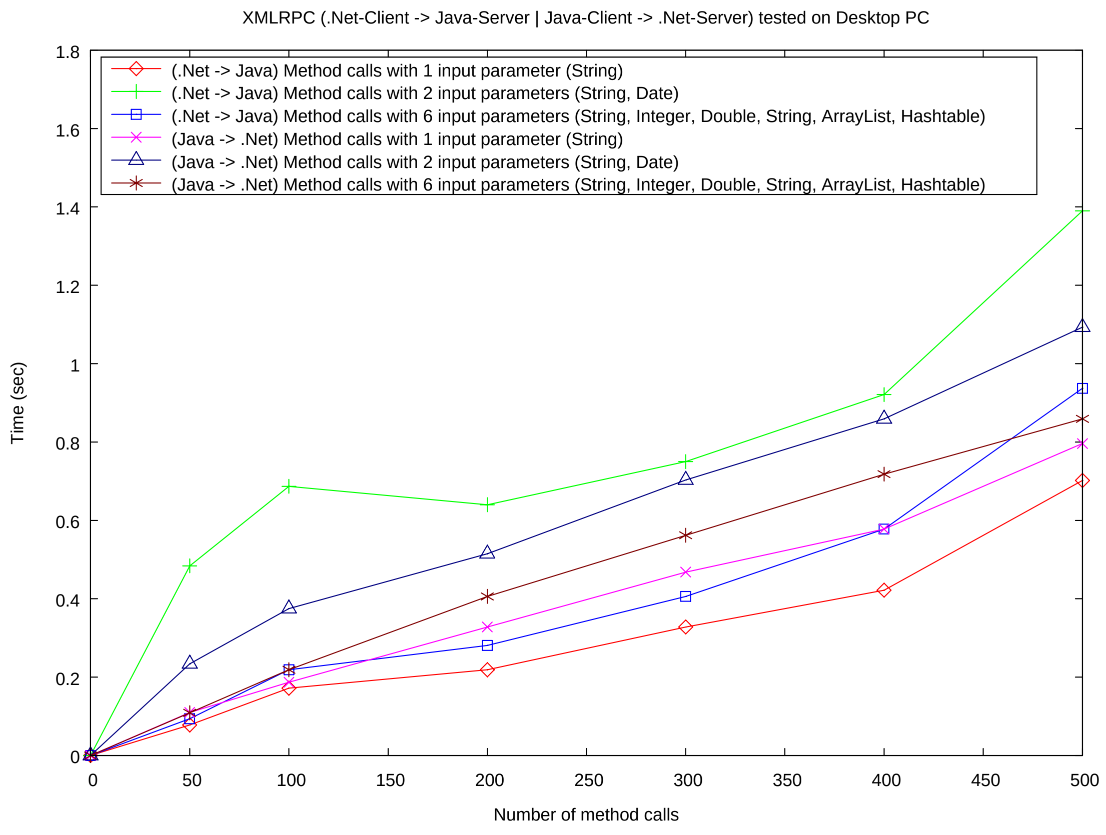
- .NET Framework SDK 2.0
- XmlRpcCS Version 1.10
- Development environment used: Visual Studio .NET 2005

3. Test results

The following figure shows the result of the test-runs on the OQO:



For comparison the tests were repeated on a standard PC:



4. Review of results

Most importantly, XML-RPC is a viable option for interoperability between .NET and JAVA. This has been proved in both calling directions. Moreover, XML-RPC is a good implementation candidate for objects of limited complexity.

The results show an approximated performance of about 50 method calls/sec on the OQO with expected variances depending on the number of arguments. Actually if a complex object is involved the construction of such objects in the test-programs causes an essential rise in computing time. The differences between server and client roles indicate differences in the implementation in the libraries used (as they are open source, they are subject to improvement). A detailed factorization was not part of this investigation.

Although “misused” in a local environment to establish a bridge between different software technologies, XML-RPC performs reliably. XML-RPC should evidently not be used, if a) continuously more than 10 messages/secs are expected (assuming that some time is needed to do some reasonable processing) or b) many different subsystems are to be coupled locally.

Aside from the local use, the strength of XML-RPC lies clearly in a distributed scenario where such calls are transferred between systems. Especially with a limited bandwidth the considerable smaller size of XML-RPC messages in comparison to SOAP messages is a great benefit.

Another benefit of using XML-RPC is that moving such components from a local communication scheme to a remote one with server/client located on different machines connected by the Internet is simple, since XML-RPC is HTTP/HTTPS driven by default.

5. Listings

The following listings present the core source of our test implementation. It has been quite straightforward and may help as a short additional guide on how to build an individual (and more functional) bridge between .NET and JAVA components.

5.1. C#

5.1.1. Server

```
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 */
using System;
using System.Collections.Generic;
using System.Diagnostics;
using System.Text;
using Nwc.XmlRpc;

namespace ObjectServer {
    class ObjectServer : XmlRpcServer {
        const int PORT = 9118;

        public ObjectServer() : base(PORT) {
        }

        public ObjectServer(int port) : base(port) {
        }

        /// <summary>Simple logging to Console.</summary>
        static public void WriteEntry(String msg, LogLevel type) {
            if (type != LogLevel.Information) { // ignore debug msgs
                Console.WriteLine("{0}: {1}", type, msg);
              }

            }


        /// Application starts here.
        public static void Main(string[] args) {
            // Use the console logger above.
            Logger.Delegate = new Logger.LoggerDelegate(WriteEntry);

            ObjectServer server = new ObjectServer(PORT);
            server.Add("container", new ObjectContainer());
            Console.WriteLine("Web Server Running on port {0} ... Press ^C to Stop...", PORT);
            server.Start();
        }
      }
}
```

5.1.2. Client

```
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 */
using System;
using System.Collections.Generic;
using System.Collections;
using System.Text;
using Nwc.XmlRpc;

namespace ObjectClient {
    class ObjectClient {
        static string server_url = "http://127.0.01:9117";

        static void Main(string[] args) {
            int maxMethodCall = 500;
            DateTime t1;
                        DateTime t2;
            XmlRpcRequest client = new XmlRpcRequest();
            XmlRpcResponse response;

            if (args.Length > 0) {
                maxMethodCall = Int32.Parse(args[0]);
            }

            Console.WriteLine("==========Send objects - 2 input parameters - started==========");
            Console.WriteLine("Count of the method calls: " + maxMethodCall);
                        t1 = DateTime.Now;

            for (int i = 0; i < maxMethodCall; i++) {
                client.MethodName = "container.add";
                client.Params.Clear();
                client.Params.Add(i.ToString() + "_m1");
                client.Params.Add(DateTime.Now);
                response = client.Send(server_url);
                //Console.WriteLine(response.Value);
                        }

            t2 = DateTime.Now;

            Console.WriteLine("==========Send objects - 2 input parameters - finished==========");
            Console.WriteLine("Total time = " + (t2 - t1) + "msec");

            Console.WriteLine("==========Send objects - 6 input parameters - started==========");
            Console.WriteLine("Count of the method calls: " + maxMethodCall);
            t1 = DateTime.Now;

            for (int i = 0; i < maxMethodCall; i++) {
                client.MethodName = "container.add";
                client.Params.Clear();
                client.Params.Add(i.ToString() + "_m2");
                client.Params.Add(i);
                client.Params.Add((Double) i);
                client.Params.Add(i.ToString());
                ArrayList l = new ArrayList();
                l.Add(i.ToString());
                l.Add(i + 1);
                client.Params.Add(l);
                Hashtable t = new Hashtable();
                t.Add(i.ToString(), i.ToString());
                Int32 j = i + 1;
                t.Add(j.ToString(), j);
                client.Params.Add(t);
                response = client.Send(server_url);
                //Console.WriteLine(response.Value);
            }

            t2 = DateTime.Now;

            Console.WriteLine("==========Send objects - 6 input parameters - finished==========");
            Console.WriteLine("Total time = " + (t2 - t1) + "msec");


            Console.WriteLine("==========Send objects - 1 input parameter - started==========");
            Console.WriteLine("Count of the method calls: " + maxMethodCall);
            t1 = DateTime.Now;

                        for (int i = 0; i < maxMethodCall; i++) {
                client.MethodName = "container.get";
                client.Params.Clear();
                client.Params.Add(i.ToString() + "_m1");
                response = client.Send(server_url);
                //Console.WriteLine(response.Value);
            }

                        t2 = DateTime.Now;

            Console.WriteLine("==========Send objects - 1 input parameter - finished==========");
            Console.WriteLine("Total time = " + (t2 - t1) + "msec");
        }
    }
}
```

5.2. JAVA

5.2.1. Server

```
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 */
import org.apache.xmlrpc.*;

public class ObjectServer extends WebServer {
        private static final int PORT = 9117;

        public ObjectServer() {
                super(PORT);
        }

        public ObjectServer(int port) {
                super(port);
        }

        public static void main(String args[]) {
                try {
                        //XmlRpc.setKeepAlive(true);
                        //XmlRpc.setDebug(true);
                        ObjectServer server = new ObjectServer();
                        //xmlrpcServer.acceptClient ("192.168.0.*"); // allow local access
                        //xmlrpcServer.acceptClient ("127.0.0.*"); // allow local access
                        server.addHandler("container", new ObjectContainer());
    System.out.println("Web Server Running on port " + ObjectServer.PORT + " ... Press ^C to Stop...");
                        server.start();
                } catch (Exception e) {
                        System.err.println("Could not initialize XMLRPC-Server");
                }
        }

}
```

5.2.2. Client

```
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 * THIS SOFTWARE OR ITS DERIVATIVES.
 */
import org.apache.xmlrpc.*;
import java.io.*;
import java.sql.Timestamp;
import java.util.Date;
import java.util.Hashtable;
import java.util.Vector;

public class ObjectClient {
        final static String server_url = "http://127.0.0.1:9118";

        public static void main(String args[]) throws XmlRpcException, IOException {
                int maxMethodCall = 500;
                Timestamp t1 = null;
                Timestamp t2 = null;
                final XmlRpcClient client = new XmlRpcClient(server_url);
                Vector params = new Vector();
                if (args.length > 0) {
                        maxMethodCall = Integer.parseInt(args[0]);
                }
                System.out.println("==========Send objects - 2 input parameters - started==========");
                System.out.println("Count of the method calls: " + maxMethodCall);
                t1 = new  Timestamp(System.currentTimeMillis());

                for (int i = 0; i < maxMethodCall; i++) {
                        params.clear();
                        params.add(String.valueOf(i) + "_m1");
                        params.add(new Date(System.currentTimeMillis()));
                        client.execute("container.addTwo", params);
                        //Object result = client.execute("container.addTwo", params);
                        //System.out.println(result);
                }
                t2 = new Timestamp(System.currentTimeMillis());

                System.out.println("==========Send objects - 2 input parameters - finished==========");
                System.out.println("Total time = " + (t2.getTime() - t1.getTime()) + "msec");
                System.out.println("==========Send objects - 6 input parameters - started==========");
                System.out.println("Count of the method calls: " + maxMethodCall);
                t1 = new  Timestamp(System.currentTimeMillis());

                for (int i = 0; i < maxMethodCall; i++) {
                        params.clear();
                        params.add(String.valueOf(i) + "_m2");
                        params.add(new Integer(i));
```

```
                    params.add(new Double(i));
                    params.add(String.valueOf(i));
                    Vector v = new Vector();
                    v.add(String.valueOf(i));
                    v.add(new Integer(i + 1));
                    params.add(v);
                    Hashtable t = new Hashtable();
                    t.put(String.valueOf(i), String.valueOf(i));
                    t.put(String.valueOf(i + 1), new Integer(i + 1));
                    params.add(t);
                    client.execute("container.addSix", params);
                    //Object result = client.execute("container.add", params);
                    //System.out.println(result);
                }
                t2 = new Timestamp(System.currentTimeMillis());
                System.out.println("==========Send objects - 6 input parameters - finished==========");
                System.out.println("Total time = " + (t2.getTime() - t1.getTime()) + "msec");
                System.out.println("==========Send objects - 1 input parameter - started==========");
                System.out.println("Count of the method calls: " + maxMethodCall);
                t1 = new  Timestamp(System.currentTimeMillis());
                for (int i = 0; i < maxMethodCall; i++) {
                    params.clear();
                    params.add(String.valueOf(i) + "_m1");
                    client.execute("container.get", params);
                    //Object result = client.execute("container.get", params);
                    //System.out.println(result);
                }
                t2 = new Timestamp(System.currentTimeMillis());

                System.out.println("==========Send objects - 1 input parameter - finished==========");
                System.out.println("Total time = " + (t2.getTime() - t1.getTime()) + "msec");
        }
}
```

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