Routing and security for remote labs for teaching and research (SRS-E-LABO)

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Abstract:
In this paper, routing services and security are software components that can be integrated in an e-laboratory or remote laboratory as well as in mobile laboratories. We will show how to implement services to manage the routing and security using virtual routers. The virtual routers that we propose allow designers to online laboratories to adapt or supplement their learning environments or dedicated platforms using their services to route and secure access to physical devices and the information passed to the various network nodes to remote laboratories. The concept to be presented, based on WCF (Windows Communication Foundation), provides centralized network management at a single location while the remote labs are based on networks and distributed systems.

Keywords: Remote labs, online laboratory, computer network, WAP, virtual router, security, e-laboratory, e-learning, WCF

1. Objectives and routing services security

This article aims to contribute to the development of service concepts, routing and security using software components that can be integrated with laboratory environments online. These software components are presented in the form of services to manage 1) addressing the various nodes of connections, 2) the table router to forward packets from networks or sub networks connected directly or indirectly to the primary node, 3) transmission security with an encryption of information, 4) public and private keys for data privacy; 5) mobile devices and applications WAP (Wireless Application Protocol) and service use in web applications by exploiting the available services. Routing services and security for remote labs for teaching and research online (SRS) are reliable and secure transactional solutions that integrate across platforms and interoperate with existing infrastructure. The SRS will be based on the WCF architecture (Windows Communication Foundation) which is compatible with all other existing architectures because "The message parameters are defined by documents in XSD (XML Schema Definition), which allows any system comprising XML (eXtended Markup Language) to manage documents. The message contract defines specific message parts using SOAP (Simple Object Access Protocol), and allows finer control of them, when interoperability demands such precision. "[1]. Figure 1 illustrates the main layers of the WCF architecture used to implement the various services of SRS.

Service contracts illustrated in Figure 1 have spoken publicly in WSDL (Web Services Description Language) [2], a format that describes network services in terms of operating parameters on messages SOAP (Simple Object Access Protocol). This allows designers to use that information to public contracts to build service oriented applications that ensures interoperability. To transfer information on intranets and the Internet, the services use protocols such as HyperText Transfer Protocol (HTTP) and Transmission Control Protocol (TCP). Other types of transport mechanisms can be added via extension points of WCF integrated.
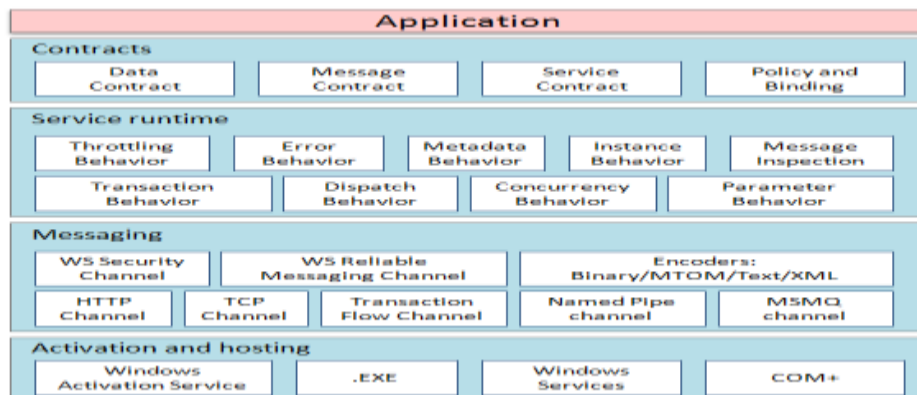

Figure 1. WCF Architecture [1]

2. Communication services routing and security

The SRS can be used either ad hoc or infrastructure. Figures 1 and 2 show the two modes of communications services, routing and security levels and applications to an established e-collaboration environment consisting of a platform for distance learning (online platform), a site laboratory Remote (e-laboratory) and another site that hosts communication tools useful for synchronous and asynchronous learning or collaborative research (Collab).

Ad hoc mode as the name suggests allows each item that uses routing services (SRS) to host and use its own services directly. These can be shared or restricted in Intranet. The communication mechanism is very simple. To deploy routing services must sequentially, initially, install a server that hosts all SRS available, then set the access "users", controls and security; mount the virtual router using local services or remote, and finally implement the global environment which exploits a remote laboratory using deletion of SRS. Information can be exchanged between sites represented by rectangles in Figure 2. Note that the communication is bidirectional.
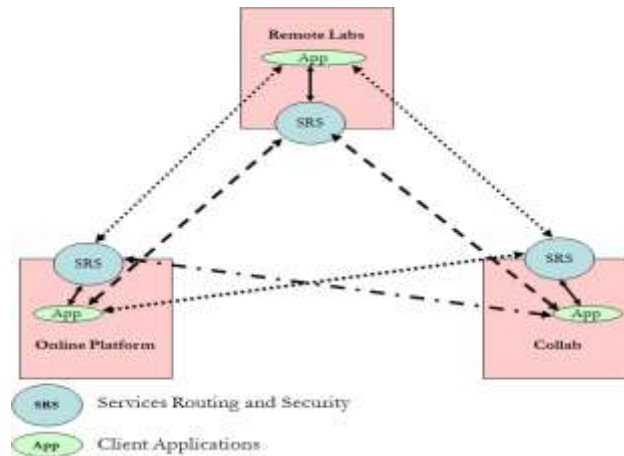

Figure 2. Communication services routing and security in ad hoc mode

The infrastructure mode shown in Figure 3 allows a centralized interconnection of SRS on a single server hosting services. This communication mode is easier to maintain when updating the system. The SRS is divided for the various sites where the possibility of overloading likely. In this case a policy of performance management and bandwidth can be introduced to give priority levels to the sites. The communication mechanism is more complex to manage, compared to ad hoc mode, but the steps to establish communication and use the services remain the same. Information can be exchanged between sites represented by rectangles in Figure 3. To do everything passes through the central node of the SRS.
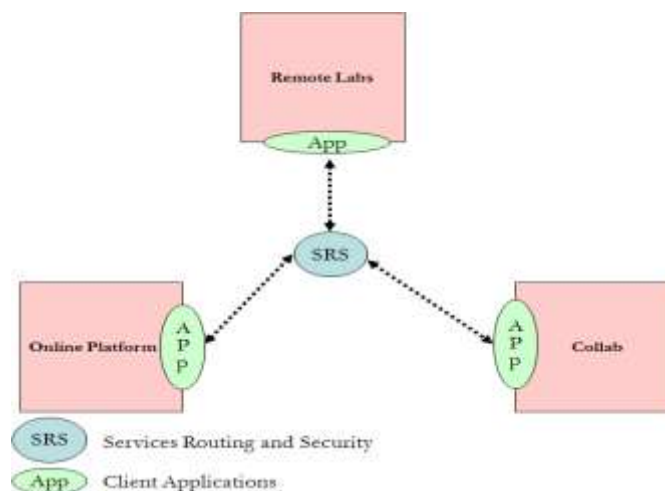

Figure 3. Communication Services Routing and Security Infrastructure mode

It is possible to combine the two basic modes for a mixed mode as shown in Figure 4.
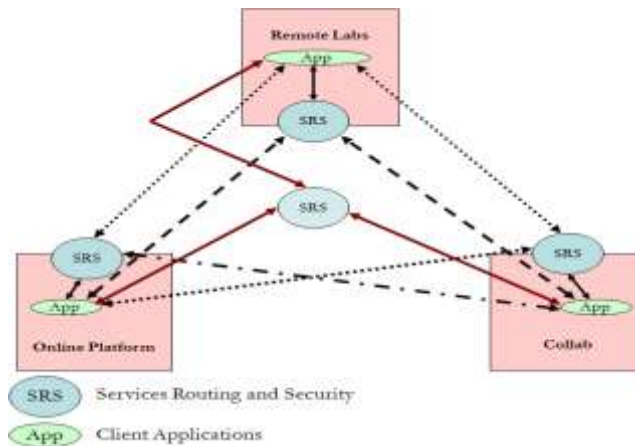
Figure 4. Communication Services Routing and Security in Mixed Mode

3. Description of services routing and security
Five management points will be treated as mentioned in Section I of this paper.

3.1. Address management of the various nodes of connections
These are services for managing the global addressing of nodes sites. As input parameters, we have the IP address of the equipment and the subnet mask that hosts SRS, the type of communication (Local, Remote, Internet-Remote Intranet VPN: Virtual Private Network, etc. ...) as well as the connection mode (ad-hoc, Infrastructure, Mixed). As output parameters, we have the IP address, physical address (MAC) and indicator connection (Connected or not connected). The information will be stored in a database for tracking, transactions and security. These services allow us to have as well an overview of the system based on information collected at nodes or sites. It is even possible to make the overall network diagram that uses SRS.

3.2. Management table router to forward packets from networks or sub networks connected directly or indirectly to node
These are services that manage the routing tables stored in a database routing. Virtual routes are defined to facilitate transport and routing information. As input parameters, we have the source address of the original node and the address (es) recipient (s) of the end node or end nodes. As output parameters, we have the packet flow of information from the nodes and the safety information required. It is also possible to use the broadcast address (broadcast) to transmit information at different nodes of the global network.

3.3. Security management system with a transmission of information encryption
These are services that manage the security of transmissions using an encryption system. All information transmitted from node to node will be protected by an encryption algorithm using the management services described public and private keys to the next depending on whether the information coming from the central server or a node of the central system. These services also use the information generated by the management services of the routing table. So we need the source address, destination addresses and information or applications that must pass at the nodes of the central system. Output, we have information packets encrypted and then decrypted at that node by a service recipient decryption of packets.

3.4. Management of public and private keys
These are services that manage the public and private keys. All nodes are equipped with SRS security certificate checked and authorized by a certificate authority or free. Services in place to manage effectively the keys generated by these authorities. These certificates require a subscription to these certification authorities such as, for example, Entrust and VeriSign. It is also possible, before moving to production, use some utilities to generate public and private keys as part of testing applications.

3.5. Management of mobile devices and applications and WAP services use in web applications by exploiting the available services
These services allow you to manage the connections between the central node and mobile devices. Routing services support mobile devices such as PDAs and cellular phones with WAP technology. The example of using WAP technology for online training will be used to validate the service [3]. Mobile applications can also use the services of routing and security.

4. WSDL Structure of services routing and security

The structure of the various services put in place meets the international standard WSDL documents namely:

The WSDL document will be divided into two groups of sections. The top group consists of abstract definitions, while the bottom group contains concrete descriptions. The abstract sections define SOAP messages (Simple Object Access Protocol) completely independently of the platform and language.

The definition of a set of services that can be implemented by different web sites or applications. Each WSDL document can have sections illustrated in the following diagram:
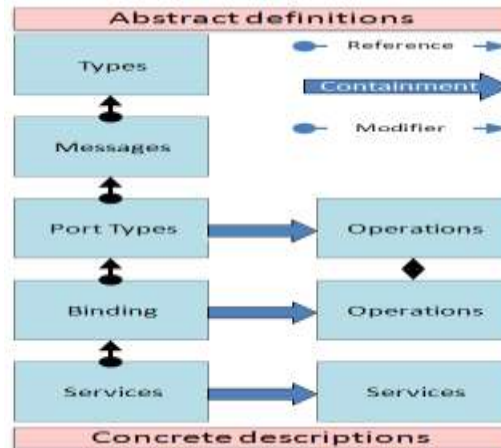

Figure 5. Structure of WSDL documents [1]

5. Results and conclusion

In this part of the article, the connection service owned management services addressing is presented. Figures 6 and 7 show the tests with the "svcutil.exe" tool from visual studio. This tool allows you to quickly test the functionality of the services developed.
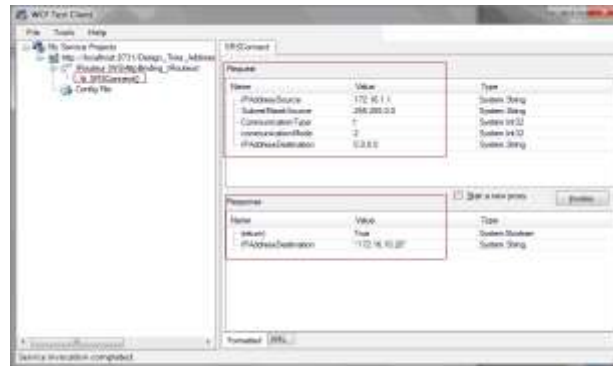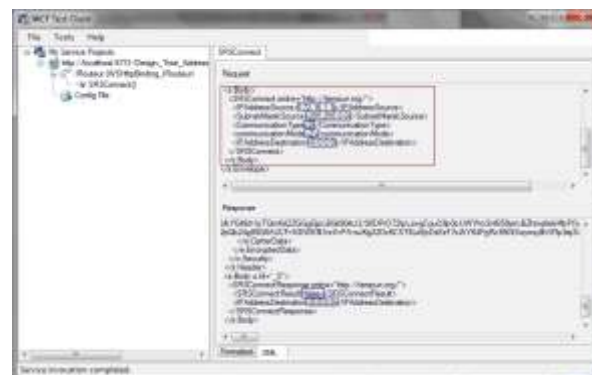

Figure 6. Testing Service SRSCONNECT

Figure 7. Representation of results in XML format

The service takes as input SRSCONNECT four parameters (information on the source node, the mode and type of communication) and establishes a connection between two nodes (virtual router). If the connection is established, the service outputs the logical and physical addresses of the remote site as well as the true indicator (connected) or false (not connected). Figures 8 and 9 show an example of using the SRS services in C # and Visual Basic. Figure 6 shows how to add references of routing services, while Figure 9 shows a web browser, the service description and a sample source code to call the SRS.
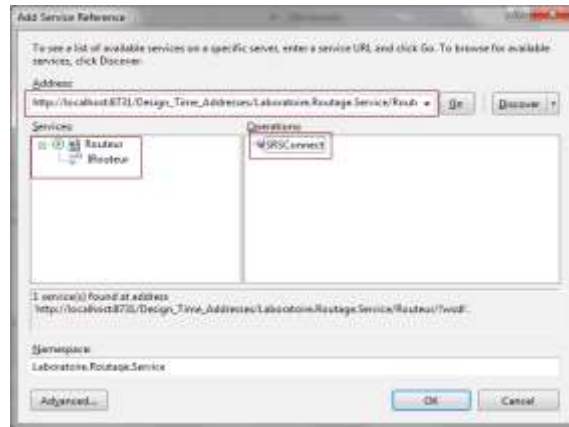

Figure 8. Reference Service SRSCONNECT on visual studio

Figure 9. Example of C # and Visual Basic provided by the online service

To test this service, the first thing to do is create a client and write the code to call the service. To do this, one possibility is to use the "svcutil.exe" tool from the command line using the following syntax:

```
svcutil.exe http://localhost:8731/Design_Time_Addresses/Laboratoire.Routage.Service/Routeur/?wsdl
```

This will create a configuration file and a code file containing the class of customer. Adding the two files to a client application and the generated client class to call up the service SRSCONNECT. The following table shows two examples, the first source code written in C # and Visual Basic in the second

C#	Visual Basic

class Test
{
  static void Main()   {
    RouteurClient client = new RouteurClient();
    //Use the variable "client" to call operations on the service.
    Client.srsconnect(ipsource, marqueSource, Type,
               Mode, IpDestination);
    //Always close the client.
    client.Close();   }
}
	Class Test
	    Shared Sub Main()
	      Dim client As RouteurClient = New RouteurClient()
	'Use the variable "client" to call operations on the service.
	      Client.srsconnect(ipsource, marqueSource, Type,
	             Mode, IpDestination);
	' Always close the client.
	      client.Close()
	    End Sub
	End Class

Table 1. Sample code to use the services of the routing software

Routing services and security contribute to online laboratories in the field of networks and security. With its various services in place, you can easily create an online laboratory that learners can use to do practical work and experimental without the need for physical facilities or to go to physical laboratories [4] [5]. This option allows to extend the use of laboratories using a platform accessible from a web browser or mobile device.

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