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AN EFFECTIVE MAPPING ARCHITECTURE BETWEEN TWO HETEROGENEOUS SIGNALING PROTOCOLS

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ABSTRACT

Nowadays, Multimedia Communication has been improved rapidly to allow people to communicate via the Internet. However, Internet users cannot communicate with each other unless they use the same chatting applications since each chatting application uses certain signaling protocol to make the media call. The mapping architecture is a very critical issue since it solves the communication problems between any two protocols, as well as it enables people around the world to make a voice/video call even they use different chatting applications. Providing the interoperability between different signaling protocols and multimedia applications takes the advantages of more than one protocol. Many mapping architectures have been proposed to ease exchanging of the media between at least two users without facing any difficulties. However, the design of any of the existing mapping architectures has some weaknesses related to larger delay, time consuming, and security matters. The only way to overcome these problems is to propose an efficient protocol 1-protocol 2 mapping architecture. The proposed mapping architecture consists of protocol 1 domain (protocol 1 client, protocol 1 server, protocol 1-to-protocol 2 gateway), and protocol 2 domain (protocol 2 client, protocol 2 server, protocol 2-to-protocol 1 gateway). The tasks of the translation gateways are represented by the URI conversion, media capability exchange, translator of call setup and teardown signals, and real time media transmission.

Keywords: Signaling protocol, mapping, media conferencing, translation gateway.

INTRODUCTION

Over the last decade, multimedia techniques have been developed rapidly to enable users to communicate between each other over the internet using all types of chatting services such as instant messages, audio, and video. However, users cannot phonetically communicate with each other unless they use the same chatting applications since each chatting application has its own control protocol to handle the call setup, the real time media transmission, and the call teardown sessions (Saravanan and Ramadass, 2000).

Due to the appearance of many signaling protocols (Spencer, 2004; Ingo, 2011; Glasmann *et al*., 2003; Ramadass *et al*., 1997) media conferencing systems and Internet Protocol (IP) applications, the interoperability has become very necessary to provide full end-to-end connectivity and to give users the flexibility to select their preferred applications as long as there is a method or mechanism that allows bridging the gap between the heterogeneous signaling protocols. Furthermore, the multimedia communication service providers understand that users want to communicate with each other regardless of the service provider and protocol used on their IP network.

The only way to enable the users to communicate phonetically using different chatting applications is to design a new mapping architecture for any two control protocols used by different chatting applications (Oishi *et al*., 2007). However, three main problems have been faced by the researchers when they have proposed a mapping architecture between two different protocols, such as the number of translation gateways used, by using only one translation gateway in the mapping architecture, the translation gateway will be responsible for checking whether the packet received belongs to protocol 1 client or protocol 2 client before translates the packet and sends it to the other party. The checking step has to be done for each received packet by the translation gateway as well as the gateway is responsible for handling sending, receiving the packets for both protocol 1 and protocol 2 clients, in addition to translate the packets from protocol 1 format to protocol 2 format and vice versa since it is the only gateway that handles the signaling and media sessions. Therefore, using one translation gateway will lead to larger delay time compared to using more than one translation gateway. The second main problem is that using the client's own server not only in registration but also in the signaling session. In this case, the translation gateway should obtains admission from the client's server for each signaling message which leads to repeated signaling messages and time consuming for each request-response by the

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client side. The third main problem is using the translation gateway for registration purpose by the client which is less reliable and easy to be hacked. Therefore, by overcome the aforementioned problems related to the previous mapping architectures, an efficient mapping architecture between two heterogeneous protocols has to be built.

PROBLEMS WITH PREVIOUS WORKS

Figures 1 - 8 present the cases of eight existing mapping architectures with the problems of each case which lead to propose an efficient protocol 1-protocol 2 mapping architecture.

Case 1: Both protocol 1 and protocol 2 clients register, setup/teardown the call, and make the audio/video call directly through the protocol 1-protocol 2 translation gateway (Kolhar, 2010).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- Protocol 1 and Protocol 2 clients' registration with the protocol 1-protocol 2 gateway are less reliable and need a very strong security system provided by both protocols' clients.

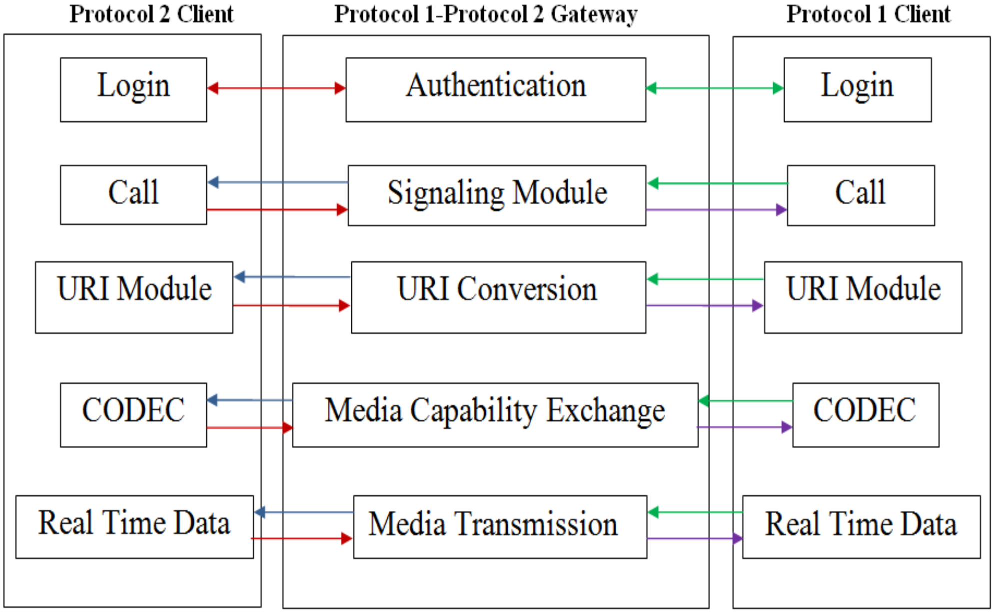


Fig. 1. Existing Mapping Architecture: Case 1.

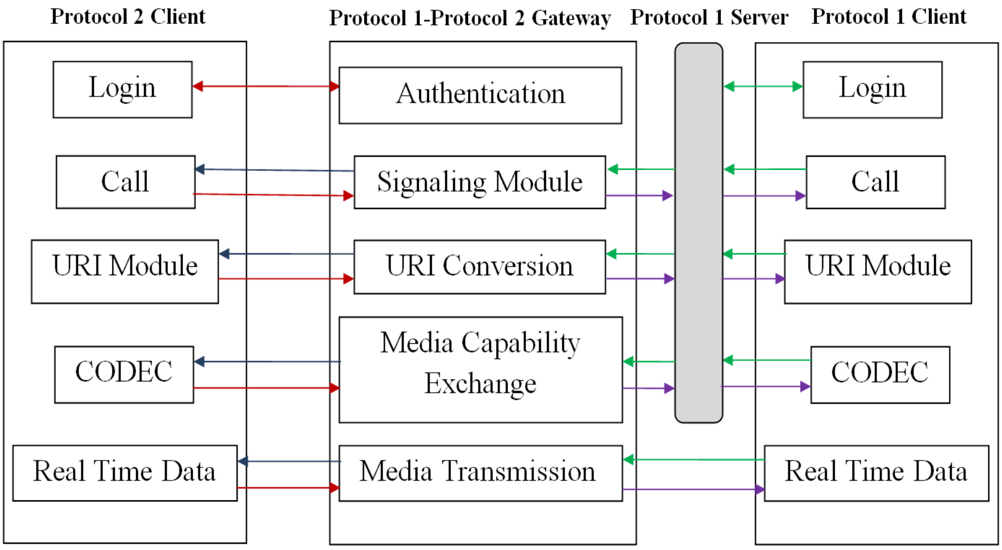


Fig. 2. Existing Mapping Architecture: Case 2.

Case 2: Protocol 1 client registers with its respective server, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server during only the signaling session, during media session, the clients exchange the media packets directly via the translation gateway without the existence of the client's respective, whereas, protocol 2 client registers, setup/teardown the call, and makes the audio/video call directly through the protocol 1-protocol 2 translation gateway (Singh, 2006).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- The translation gateway obtains admission from the protocol 1 server for each signaling message which leads to repeated signaling messages and time consuming for each request-response by protocol 1 side.
3- Protocol 2 client's registration with the protocol 1-protocol 2 gateway is less reliable and need a very strong security system provided by protocol 2 client.

Case 3: Protocol 1 client registers, setup/teardown the call, and makes the audio/video call directly through the protocol 1-protocol 2 translation gateway, whereas, protocol 2's client registers with its respective server, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server during only the signaling session, during media session, the clients exchange the media packets directly via the translation gateway without the existence of the client's respective (Kolhar *et al*., 2008).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- The translation gateway obtains admission from the protocol 2's server for each signaling message which leads to repeated signaling messages and time consuming for each request-response by protocol 2 side.

3- Protocol 1 client's registration with the protocol 1-protocol 2 gateway is less reliable and need a very strong security system provided by protocol 1 client.

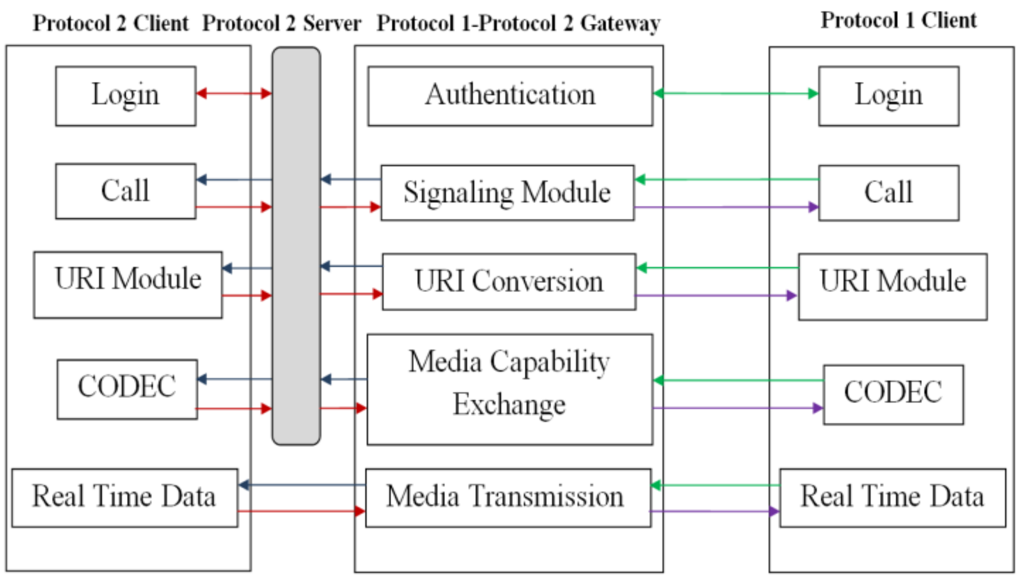


Fig. 3. Existing Mapping Architecture: Case 3.

Case 4: Both protocol 1 and protocol 2 clients register with their respective servers, the clients exchange the control and media packets directly via the protocol 1-protocol 2 translation gateway without the existence of the client's respective server during both signaling and media transmission sessions (Schulzrinne and Agboh, 2004).

Problems: Larger packet delay by using one translation gateway compared to using more than one translation gateway.

Case 5: Protocol 1 client registers with its respective server, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server during only the signaling session, during media session, the clients exchange the media packets directly via the translation gateway without the existence of the client's respective server, whereas, protocol 2 client registers with its respective server, the clients exchange the control and media packets directly via the protocol 1-protocol 2 translation gateway without the existence of the client's respective server during both signaling and media transmission sessions (Zhang, 2002).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- The translation gateway obtains admission from the protocol 1 server for each signaling message which leads to repeated signaling messages and time consuming for each request-response by protocol 1 side.

Case 6: Protocol 1 client registers with its respective server, the clients exchange the control and media packets directly via the protocol 1-protocol 2 translation gateway without the existence of the client's respective server during both signaling and media transmission sessions, whereas, protocol 2 client registers with its respective server, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server during only the signaling session, during media session, the clients exchange the media packets directly via the translation gateway without the existence of the client's respective server (Wang *et al*., 2004).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- The translation gateway obtains admission from the protocol 2 server for each signaling message which leads to repeated signaling messages and time consuming for each request-response by protocol 2 side.

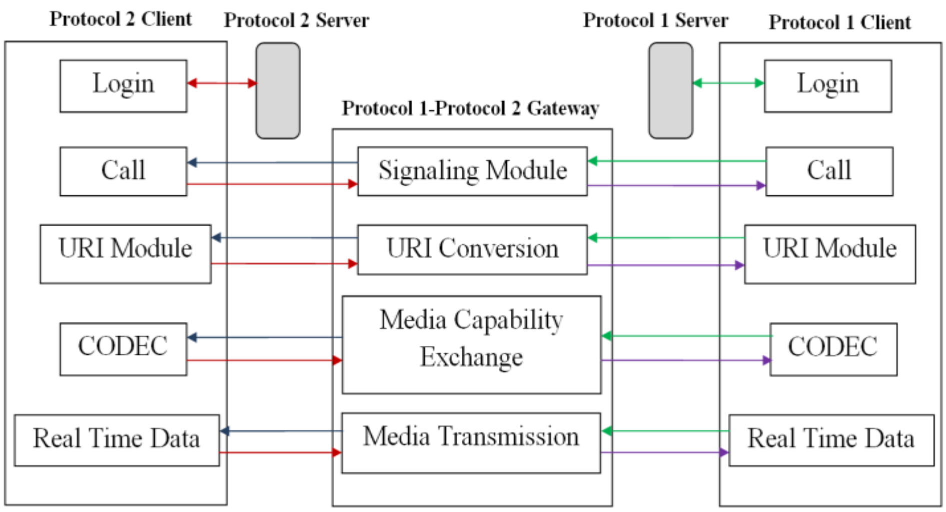


Fig. 4. Existing Mapping Architecture: Case 4.

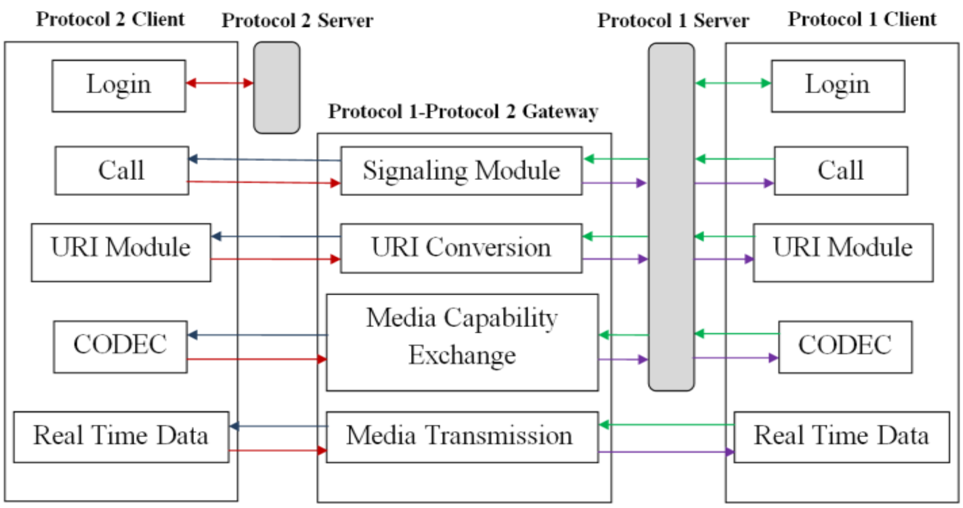


Fig. 5. Existing Mapping Architecture: Case 5.

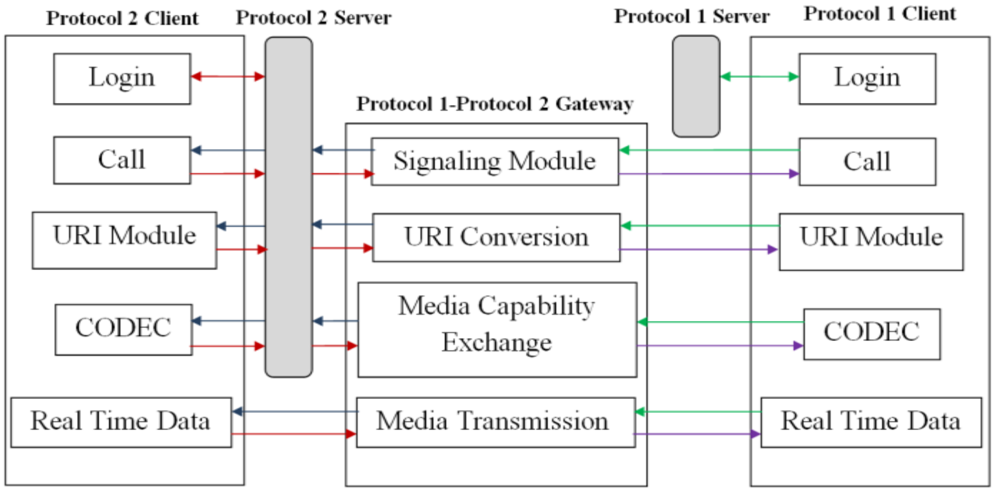


Fig. 6. Existing Mapping Architecture: Case 6.

Case 7: Both protocol 1 and protocol 2 clients register with their respective servers, dealing with the protocol 1-protocol 2 translation gateway with the existence of the client's respective server during only the signaling session, during media session, the clients exchange the media packets directly via the translation gateway without the existence of the client's respective server (Dagiuklas *et al*., 2005).

Problems: 1- Larger packet delay by using one translation gateway compared to using more than one translation gateway.

2- The translation gateway obtains admission from both protocol 1 and protocol 2 servers for each signaling message which leads to repeated signaling messages and time consuming for each request-response by both protocol 1 and protocol 2 sides.

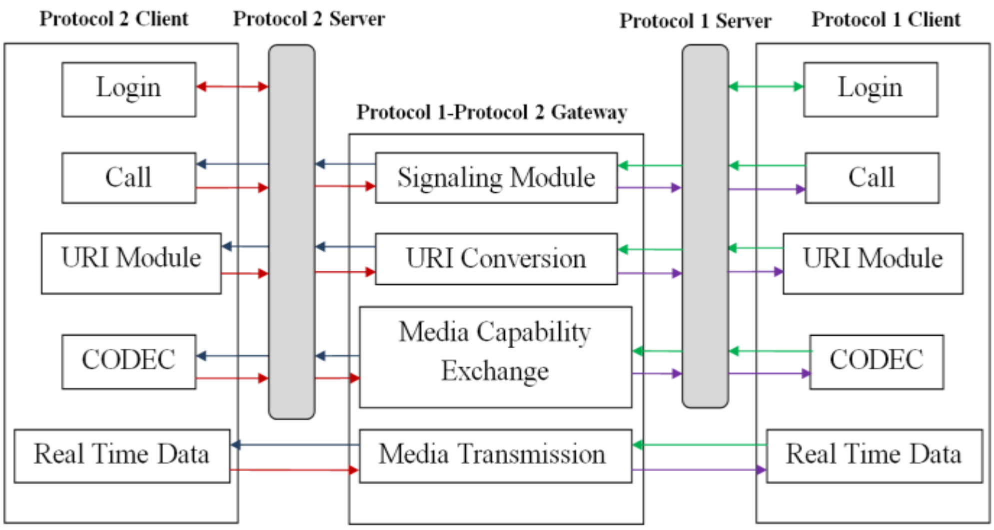


Fig. 7. Existing Mapping Architecture: Case 7.

Case 8: Both protocol 1 and protocol 2 clients register with their respective servers, dealing with both protocol 1-to-protocol 2 and protocol 2-to-protocol 1 translation gateways with the existence of their respective servers during only the signaling session, during media session, the clients exchange the media packets directly via the two translation gateways without the existence of their respective servers (Saint-Andre *et al*., 2015).

Problems: The translation gateway obtains admission from both protocol 1 and protocol 2 servers for each signaling message which leads to repeated signaling messages and time consuming for each request-response by both protocol 1 and protocol 2 sides.

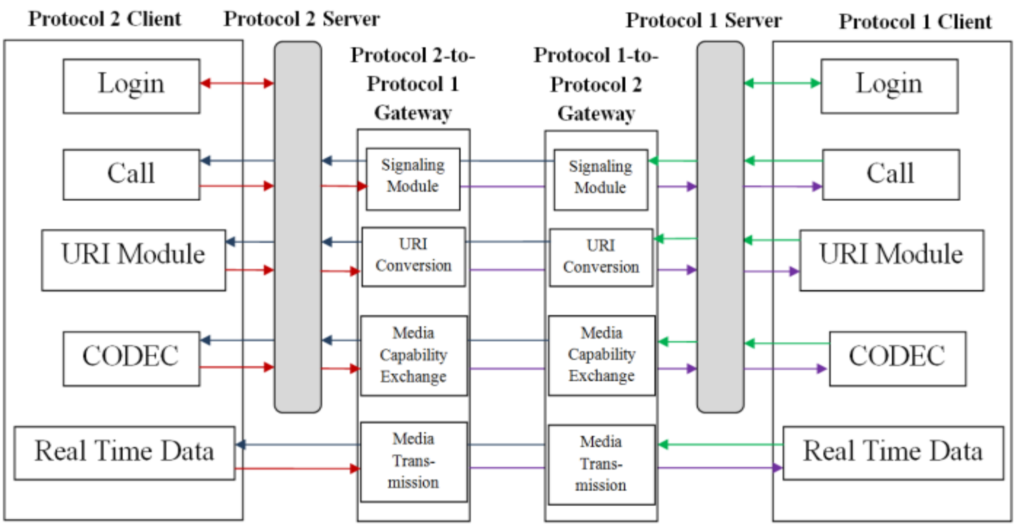


Fig. 8. Existing Mapping Architecture: Case 8.

Based on the eight existing architectures, the proposed mapping architecture is built to overcome the aforementioned problems faced when using anyone of the previous mapping architectures.

PROPOSED MAPPING ARCHITECTURE

As shown in Figure 9, the proposed mapping architecture consists of protocol 1 client, protocol 1 server, protocol 2 client, protocol 2 server, protocol 1-to-protocol 2 gateway, and protocol 2-to-protocol 1 gateway. Protocol 1 and protocol 2 servers coordinate protocol 1 and protocol 2 clients respectively during registration session only, whereas protocol 1-to-protocol 2 and protocol 2-to-protocol 1 gateways coordinate protocol 1 and protocol 2 clients during signaling and media sessions, as well as both gateways should maintain a look-up table to provide address resolution for both protocol 1 and protocol 2 clients. Both translation gateways are included in the mapping architecture to ease storing, sending/ receiving, and translating the format of the messages.

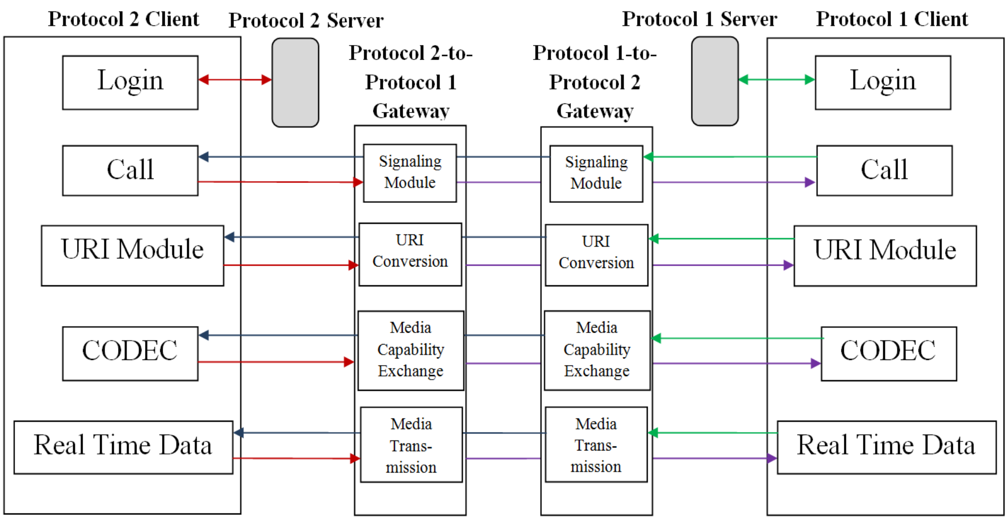
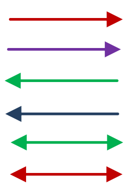


Fig. 9. The Proposed Mapping Architecture.

Where:



The message sent by protocol 2's client to protocol 2-to-protocol 1 gateway.
The protocol 2 translated message sent by protocol 2-to-protocol 1 gateway to protocol 1's client.
The message sent by protocol 1's client to protocol 1-to-protocol 2 gateway.
The protocol 1 translated message sent by protocol 1-to-protocol 2 gateway to protocol 2's client.
The registration message exchanged between protocol 1's client and protocol 1's server.
The registration message exchanged between protocol 2's client and protocol 2's server.

The main function of protocol 1-to-protocol 2 gateway is to receive the signaling or media data message from protocol 1 client, store the message inside the translation gateway, convert the format of protocol 1 message to the format of protocol 2 message, and forward the converted message to the protocol 2 client, whereas the main function of protocol 2-to-protocol 1 gateway is to receive the signaling or media data message from protocol 2 client, store the message inside the translation gateway, convert the format of protocol 2 message to the format of protocol 1 message, and forward the converted message to the protocol 1 client. Both protocol 1-to-protocol 2 and protocol 2-to-protocol 1 gateways provide seamless connectivity between protocol 1 and protocol 2 clients without modifying the clients' architecture.

The Performance of the Proposed Mapping Architecture compared to the Existing Mapping Architectures

The proposed protocol 1-Protocol 2 mapping architecture are built to solve the problems faced in the existing mapping architectures, such as larger delay time when using one translation gateway in the mapping architecture, including the registration session in the translation gateway instead of the client's respective server, and the existence of client's respective server during the signaling session.

1- In view of the aforementioned problems in the existing architectures, the proposed mapping architecture uses two translation gateways, by distributing the function of translation gateway into two gateways (protocol 1-to-protocol 2 and protocol 2-to-protocol 1), each gateway receives only from one party and sends only to the other party, in this case, there is no need to check by the gateway the source of each sent/received packet, and since each translation gateway handles only one direction, the two translation methods (protocol 1-to-protocol 2 and protocol 2-to-protocol 1) have to be distributed between the two translation gateways, so each translation gateway performs only one translation method. This makes the function of each gateway is simpler and lead to less delay time compared to use one translation gateway.

2- The proposed mapping architecture uses the client's server for registration session to ensure a very high security system, whereas the translation gateways are used during signaling and media transmission sessions so the translation gateways can deal directly with the clients. Thus, no need to obtain permission from the server for each signaling message sent to or received from the client as the translation gateway maintains a look-up table to provide address resolution and signaling and media messages translation.

CONCLUSION

This paper illustrated the problems in the existing mapping architectures between two different protocols, and how we overcome these problems by proposing an efficient mapping architecture and providing a comprehensive interoperability between protocol 1 and protocol 2 clients. In the future, we will test the validity of the proposed mapping architecture and see how the proposed architecture is better in performance compared to the existing architectures in terms of packet delay, packet loss, and jitter.

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