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TITLE: An endpoint-oriented approach to implementing supplementary services for the H.323 call model

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In this contribution we describe a new approach to providing supplementary services for the H.323 call model, in which the SS-related functions are implemented in the endpoints rather than in centralised components like gatekeepers, switches or routers. Information needed for the control of the SSs are exchanged directly between the endpoints using the H.225 direct signalling channel. In case of gatekeeper routed signalling, the SS-related control information are transferred transparently by the gatekeeper to the receiving endpoints.

1. Introduction

In recommendation H.323 two options are defined for the exchange of signalling messages. In the first method, called "Gatekeeper Routed Call Signalling", the signalling messages are routed through the gatekeeper. In the second method, the "Direct Endpoint Call Signalling", the signalling messages are exchanged directly between the endpoints without involvement of the gatekeeper.

Regarding the supplementary services (SSs), recommendation H.323 refers only to the Q.931, Q.932, and the Q.95X series of recommendations. It however does not specify how the SS-related messages (Facility, Hold, Retrieve, etc.) are handled by the gatekeeper or by the endpoints. Furthermore, Recommendations Q.932 and Q.95X assumed that all the SS-related functions are implemented in the "network". In case of gatekeeper routed signalling, one can interpret that the SS-related functions are implemented by the gatekeeper. But in case of direct endpoint signalling it is not clear whether they are implemented by the endpoints or not.

In this contribution we describe an approach which exploits the direct signalling capability between the endpoints to implement such SSs like call forwarding, call waiting, call hold, etc.. In the next section we will present the basic principles of the approach followed by some examples illustrating how some typical SSs could be implemented. Finally, section 3 contains some concluding remarks.

2. Description of the approach

As mentioned before, in case of direct endpoint signalling we exploit the existence of the direct signalling channels between the two endpoints involved in a call to exchange the information required for the implementation and execution of the SSs. In case of gatekeeper routed signalling, the gatekeeper will transfer the SS-related information sent by one endpoint transparently (i.e. without modifications) to the other one. In any case, neither the gatekeeper nor the switches/routers between the endpoints are involved in the execution of the SS-related functions. They only provide the means to the endpoints for exchanging control
information between them.

In the remaining of this section we will illustrate how some supplementary services can be implemented using our endpoint-oriented method.

2.1 Call Forwarding No Reply (CFNR)

As defined in Q.952 the CFNR SS "permits a served user to have the network send all incoming calls, ..., which meet no reply and are addressed to the served user's ISDN number to another number". If that SS is active, the network will offer an incoming call by means of an SETUP message, see Figure 1. On receiving an ALERTING from the called user, the network starts timer T(cfnr). If T(cfnr) expires before the network receives a CONNECT message, the network redirects the call to the forwarded-to address.

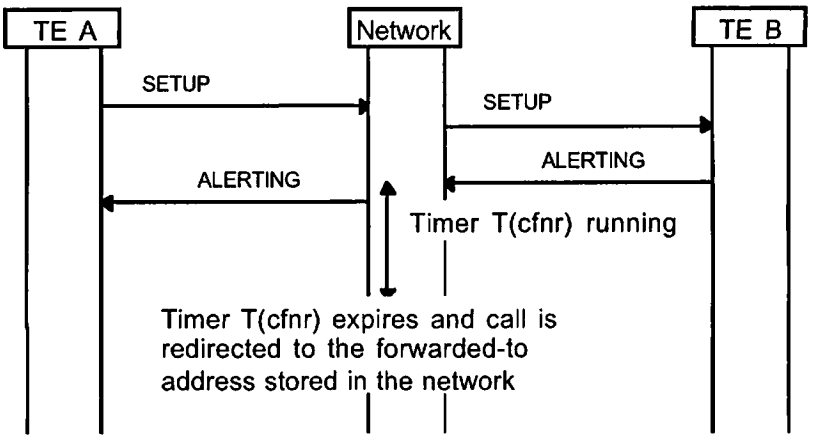

Figure 1: Q.952 CFNR supplementary services

From the above description one can recognise that all the SS-relevant functions are located in the network, e.g. timer T(cfnr), call redirection, ...

Let us now consider the H.323 direct endpoint call signalling. In this case both the SETUP and the ALERTING messages are exchanged directly between the calling and the called endpoints. There is no network in-between that would intercept the ALERTING message and execute the CFNR SS.

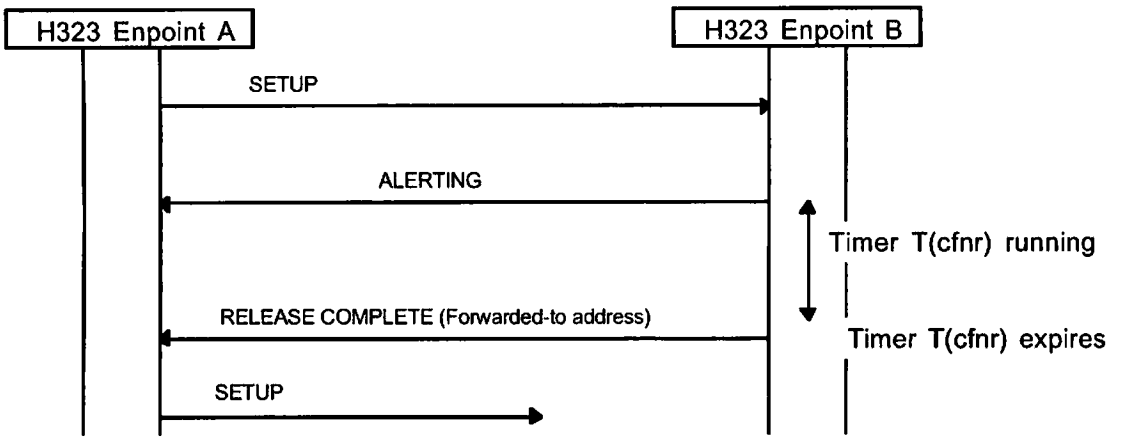

Figure 2: Endpoint-oriented CFNR

Figure 2 now describes the new, endpoint-oriented approach to the CFNR SS. After responding to the SETUP message with the ALERTING message, the called endpoint starts timer T(nfcr) and waits for its user to accept the incoming call. If T(nfcr) expires and the called user does not accept the call, the called endpoint terminates the call by sending a RELEASE COMPLETE to the calling endpoint. The RELEASE COMPLETE message contains among other information the forwarded-to address. Upon receiving the RELEASE COMPLETE message, the calling endpoint also terminates the current call and sets up a new one to the forwarded-to address. In case of gatekeeper routed signalling the gatekeeper should transfer the RELEASE COMPLETE message without any changes to the calling endpoint, thus allowing it to receive the forwarded-to address and to set-up the new call. The example of the CFNR SS described in this section can be extended in a straightforward manner to other SSs like call forwarding busy or call deflection.

2.2 Call Hold

As defined in Q.953 a user can put a call on hold by sending a HOLD message to the network (see Figure 3), which is acknowledged by an HOLD ACKNOWLEDGE message. The user can then for example uses the freed B-channel to set-up a new call. The user can also retrieve the held call by means of a RETRIEVE message.

The above definition was made under the assumption that the user has only a limited number of B-channels available and therefore wants to share a B-channel between multiple calls.

In H323 the situation is different. Since we are on LANs, there are no B-channels to carry the audio-video signals, but logical channels implemented by transport connections such as TCP/IP connections. To be able to reuse the bandwidth of the current transport connection the HOLD message should be sent to the remote endpoint requiring it to stop sending over that connection. This could be accomplished easily in case of direct endpoint signalling, as shown in Figure 3. The remote endpoint will then stop sending audio-video packets over the corresponding connection and sends back an HOLD ACKNOWLEDGE message to inform the requesting endpoint that it could now use the freed bandwidth for another connection. Both endpoints may also inform their gatekeepers about the held connection for the purpose of bandwidth management.

In case of gatekeeper routed signalling, the gatekeeper forwards the HOLD and HOLD ACKNOWLEDGE messages without any changes further to the receiving endpoints. It may also use that information for its bandwidth management. The handling of the RETRIEVE and RETRIEVE ACKNOWLEDGE is performed in a similar way.

Note that the switches/routers between the endpoints are not aware of the hold and retrieve actions, i.e. the call hold SS can be introduced without requiring the switches/routers to implement the hold and retrieve functions as in case of Q.932.

3. Conclusion

In this contribution we have described an approach for providing supplementary services in the H323 call model, in which the SS-related functions are implemented in the endpoints. Information needed for the control of the SSs are exchanged directly between the endpoints using the H.225 direct signalling channel. In case of gatekeeper routed signalling, the SS-related control information are transferred transparently by the gatekeeper to the corresponding endpoints.

Compared to the conventional Q.932 model where the SS-related functions are implemented by the network, the endpoint-oriented model described in this contribution exhibits the following advantages:

- Since the SS-related functions are located in the endpoints, the processing power available in the endpoints can be used to provide a more flexible user interface;
- Moving the SS-related functions to the endpoints permits the implementation of new SSs with no changes in the network infrastructure; this may lead to a faster introduction of news Sss;
- The same applies for the modification of existing Sss;
- Moving functions to the endpoints also means reduction of complexity and cost of centralised components (e.g. switches, gatekeeper).