Network Working Group
Request for Comments: 3136
Category: Informational

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June 2001

The SPIRITS Architecture

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Abstract

This document describes the architecture for supporting SPIRITS services, which are those originating in the PSTN (Public Switched Telephone Network)and necessitating the interactions between the PSTN and the Internet. (Internet Call Waiting, Internet Caller-ID Delivery, and Internet Call Forwarding are examples of SPIRIT services.) Specifically, it defines the components constituting the architecture and the interfaces between the components.

1. Introduction

This document describes the architecture for supporting SPIRITS services, which are those originating in the PSTN (Public Switched Telephone Network) and necessitating the interactions between the PSTN and the Internet. (Internet Call Waiting, Internet Caller-ID Delivery, and Internet Call Forwarding are examples of SPIRIT services.) Specifically, it defines the components constituting the architecture and the interfaces between the components.

The rest of the document is organized as follows:

+ Section 2 describes example SPIRITS services from the end-user point of view;

+ Section 3 describes the SPIRITS architecture;

+ Section 4 contains security considerations;

+ Section 5 contains acknowledgments;

+ Section 6 contains references; and

+ Appendix contains the figure.

2. Brief Description of Example SPIRITS Services

To illustrate the motivation for the overall SPIRIT architecture, this section provides a brief description of the example SPIRITS services:

+ Internet Call Waiting (ICW),

+ Internet Caller-ID Delivery, and

+ Internet Call Forwarding.

These services are considered from the end-user point of view under the assumptions below:

+ Service subscription (or cancellation) is a separate process and may be done over the telephone, via postal mail, or over the Web.

+ The subscriber's IP host (e.g., a PC) is loaded with the necessary software [including a Personal Identification Number (PIN) and the IP addresses of the SPIRITS servers] for realizing the SPIRITS services. The software may be sent by postal mail or downloaded from the Web.

+ The subscriber activates a SPIRITS service by an act of service session registration, which can take place anytime after he (or she) is connected to the Internet. The subscriber may specify the life span of the session. As soon as the session ends, the SPIRITS service is deactivated. Naturally, the subscriber should also be able to deactivate a SPIRITS service anytime during the service session.

For certain services (such as ICW or Caller-ID Delivery) the assumption is that the service subscriber has a single telephone line and a PC, which is connected to the Internet via this telephone. (Only under this assumption these services make sense.) Nevertheless, in other services (such as Web-based Call Center, in which a call center assistant could re-direct or reject a call presented in a pop-up window) this assumption may be unnecessary or even inapplicable.

2.1 Internet Call Waiting (ICW)

The Internet call waiting service enables a subscriber engaged in an Internet dial-up session to

- o be notified of an incoming call to the very same telephone line that is being used for the Internet connection;
- o specify the desirable treatment of the call; and
- o have the call handled as specified.

The details of the ICW service lie in the ways that a waiting call can be treated [1]. Typical ways for handling a call include:

+ Accept the incoming call over the PSTN by terminating the Internet connection. (As switching cannot be done immediately, the caller may hear an opening announcement followed by the "ringing" tone.)
+ Forward the incoming call to another telephone number. The subscriber will remain connected to the Internet, while the caller will hear an announcement indicating the call is being forwarded and eventually be connected to the new destination number.
+ Accept the incoming call by voice over IP. The subscriber will answer the incoming call via the already established Internet connection. (The proposed SPIRITS architecture, however, does not reflect this feature.)
+ Redirect the incoming call to voice mail. The subscriber will remain connected to the Internet, while the caller will hear an announcement inviting him (or her) to leave a message.
+ Play a pre-recorded message to the calling party and disconnect the call. The subscriber will remain connected to the Internet.
+ Reject the incoming call. The subscriber will remain connected to the Internet, while the caller will hear an announcement rejecting the call.

The subscriber may specify the call treatment on the fly when notified of an incoming call. Alternatively, the subscriber may specify a priori a general treatment for all calls (e.g., re-directed to voice mail) or call treatments tailored to the origination numbers. As a result, when a call comes in, the subscriber won’t be presented the call but can examine afterwards the treatment and outcome of the call from the log that is kept for all the calls

processed during the ICW service. Typical information recorded in the log includes the incoming call date and time, calling party number, calling party name, and call disposition.

2.2 Internet Caller-ID Delivery

This service allows the subscriber to see the caller's number or name or both while being connected to the Internet. If the subscriber has only one telephone line and is using the very line for the Internet connection, the service is a subset of the ICW service and follows the relevant description in Section 2.1. Otherwise, the subscriber's IP host serves as an auxiliary device of the telephone to which the call is first sent.

2.3 Internet Call Forwarding

The Internet call forwarding service allows a service subscriber to forward an incoming call to another telephone number while being connected to the Internet. If the subscriber has only one telephone line and is using the very line for the Internet connection, the service is a subset of the ICW service and follows the relevant description in Section 2.1. Otherwise, the subscriber's IP host serves as an auxiliary device of the telephone to which the call is first sent.

3. SPIRITS Architecture

Figure 1 of the Appendix depicts the SPIRITS architecture, which includes the following entities:

1. Service Control Function (SCF) [2], which executes service logic, interacts with the entities in the IP domain (e.g., the SPIRITS Gateway and PINT Server) through the SPIRITS Client, and instructs the switches on how to complete a call. Physically, the SCF may be located in either stand-alone general-purpose computers called Service Control Points (SCPs) or specialized pieces of equipment called Service Nodes (SNs) [2].

2. Service Switching Function (SSF) [2], which normally resides in a switch and is responsible for the recognition of Intelligent Network (IN) triggers and interactions with the SCF.

3. SPIRITS Client, which is responsible for receiving PSTN requests from the SCF as well as sending responses back. It may be co-located with the SCF. If not, it communicates with the SCF over the D interface.

4. PINT Server, which receives PINT requests from the PINT Client and relays them to the PSTN for execution over the E interface.

5. SPIRITS Gateway, which is co-located with the PINT Server or PINT Gateway (or both when they are co-located as assumed here for simplicity) and serves as an intermediary between the SPIRITS Server and SPRITS Client via the B and C interfaces, respectively.

6. PINT Client, which resides in the subscriber's IP host and is responsible for initiating PINT requests, which are sent to the PINT server over the A interface.

7. SPIRITS Server, which terminates PSTN requests and is responsible for all interactions (e.g., incoming call notification and relaying the call treatment) between the subscriber and the SPIRITS Gateway.

The rest of the Section describes the interfaces between the entities in detail.

3.1 Interface A

This interface is used for sending PINT requests to PINT Server. Its principal use is for service session registration and as a result activation of a SPIRITS service (see Section 2). In addition, this interface may be used for service subscription.

3.2 Interface B

This interface serves two main purposes: 1) to notify the subscriber of incoming calls together with the calling number and name, if available; and 2) to send to the SPRITS Gateway the subscriber's choice of call disposition specified on the fly.

3.3 Interface C

This interface is used for communications between the SPIRITS Client and SPIRITS Gateway. The SPIRITS Gateway may in turn communicate with the SPIRITS Server, or may act as a virtual server, terminating the requests without sending them down to the SPIRITS Server.

3.4 Interface D

This interface is for communications between the SPIRITS Client and the SCF. Specifically, from the SCF to the SPIRITS Client, the parameters associated with the applicable IN triggers are sent. From the SPIRITS Client to SCF, the subscriber's call disposition is sent.

The SCF "transforms" the user's disposition into appropriate actions, such as playing an announcement to the caller, and resuming the suspended call processing in the SSP.

3.5 Interface E

This interface is for sending PINT requests to the SCF for execution.

4. Security Considerations

As Figure 1 demonstrates, there are two distinct communications interfaces, B and C. The B interface is, in general, across the public Internet and is thus most vulnerable to security attacks resulting in theft or denial of service. The C interface, on the other hand is likely to be implemented across a service provider's intranet, where the security measures should be applied at the discretion of the service provider. Even then, because at least one IP host (the PINT gateway) is connected to the Internet, special measures (e.g., installation of firewalls, although this particular measure alone may be insufficient) need to be taken to protect the interface C and the rest of the network from security attacks.

The assumption that the PINT Client and SPIRITS server are co-located, dictates that the security considerations for the A and B interfaces are exactly the same. Detailed security requirements and solutions for interface A (and, consequently, B) can be found in RFC 2848 [3]. In addition, security requirements are listed in the companion SPIRITS Protocol Requirements RFC.

5. Acknowledgments

We would like to thank Alec Brusilovsky, Jorgen Bjorkner, Scott Bradner, Jim Buller, Lawrence Conroy, Jorge Gato, Dave Hewins, Naoto Makinae, and Dave Shrader for their comments and input.

6. References

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Appendix

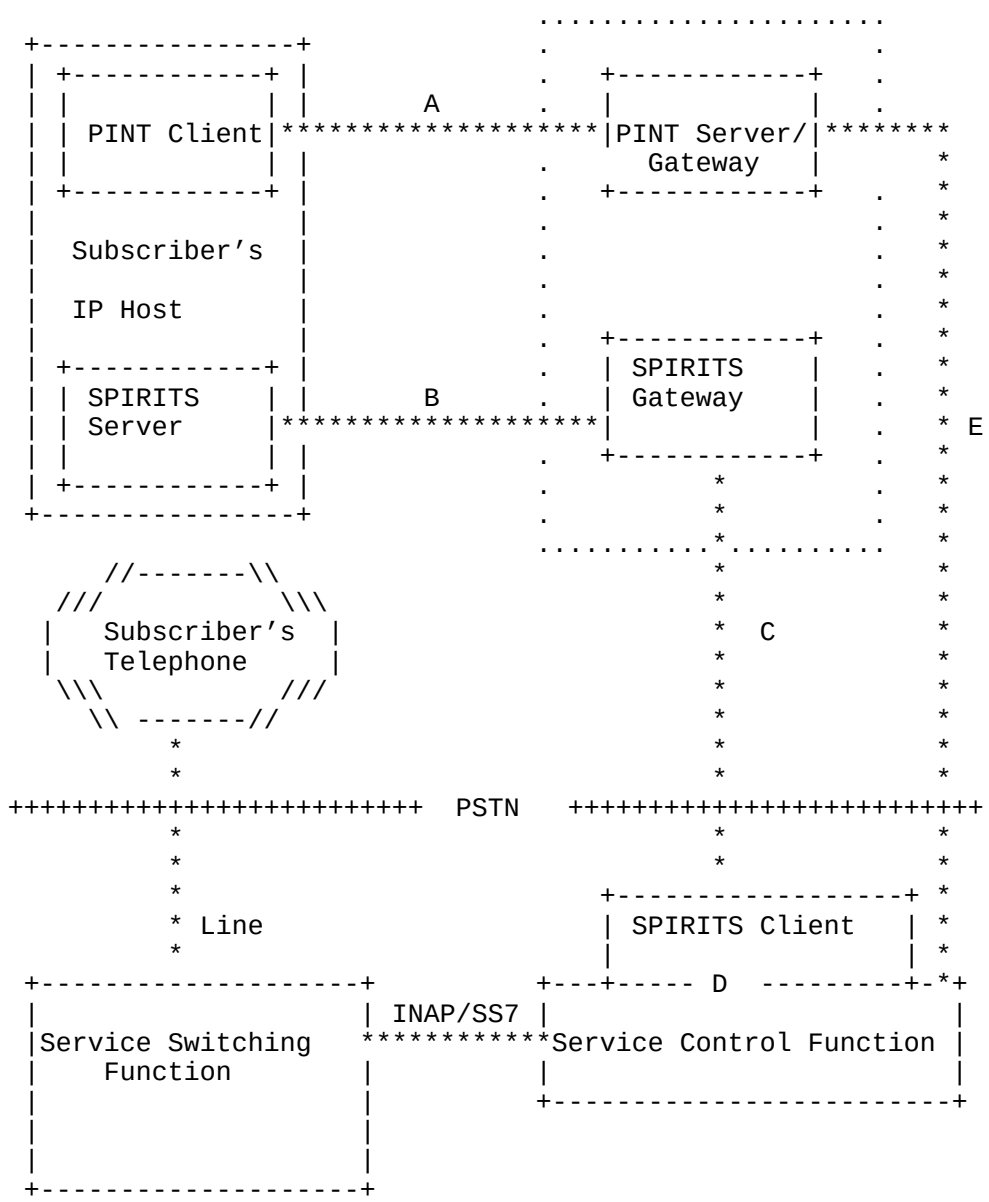

Figure 1: SPIRITS Architecture

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Acknowledgement

Funding for the RFC Editor function is currently provided by the Internet Society.