Characterizing Semantic Warnings of Service Description in Call Processing Language on Internet Telephony

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Abstract: The Call Processing Language (CPL, in short), recommended in RFC 2824 of IETF, is a service description language for the Internet Telephony. The CPL allows users to define their own services, which dramatically improves the choice and flexibility of the users.

The syntax of the CPL is strictly defined by DTD (Document Type Definition). However, compliance with the DTD is not a sufficient condition for correctness of a CPL script. There are enough rooms for non-expert users to make semantical mistakes in the service logic, which could lead to serious system down.

In this paper, we present six classes of semantic warnings for the CPL service description: MF, IS, CR, AS, US, OS. For each class, we give the definition and its effects with an example script. These warnings are not necessarily errors. However, these warnings will help users to find ambiguity, redundancy and inconsistency in their own service description.

1. Introduction

As the Internet is widely spread in society, high-quality services with the Internet are required and developed, such as Video on Demand, e-learning, on-line banking and Web services. Among the various Internet services, this paper especially focuses on the Internet telephony[3], which is also called Voice over IP (VoIP, in short). The Internet telephony has been widely studied and standardized at the protocol level (i.e., H323[5] by ITU-T, SIP[4] by IETF).

Now, the concern is shifting to the service level; how to provide supplementary services (e.g., call forwarding, voice mail, etc.) on the Internet telephony. One of the major issues is the programmable service, which allows users to define and create their own supplementary services. The Call Processing Language [2] (CPL, in short), based on XML, is recommended as a service description language in RFC2824 of the Internet Engineering Task Force (IETF) [1]. Users can deploy their own service just by putting the CPL scripts on the local VoIP server (called signalling server). This improves the range of user’s choice and flexibility, significantly.

There is, however, a drawback of the programmable service. The service description of non-experts cannot always achieve the high quality. Also, users might make faults in the CPL scripts that lead to serious system down.

To cope with this problem, this paper tries to characterize semantic warnings of service description written in the CPL. As seen in many programming languages, the warnings are not necessarily errors. However, they could cause ambiguity, redundancy and inconsistency, which are often the major source of errors. We believe that the proposed warnings will help users to improve the quality of the CPL scripts.

2. Describing services with CPL

Let us define a new service based on the following requirements, using CPL:

- I (pattara@example.com) want to receive incoming calls only from domain example.com.
- I want to reject all calls from malicious crackers (belonging to crackers.org).
- I want to redirect any other calls to my voice mail (pattara@voicemail.example.com).

Figure 1 summarizes the requirement. Figure 2 shows an implementation of the service. As in the XML, the CPL tags describe nested structures, starting from <tag> and ending with </tag>. <tag /> is an abbreviation of <tag> </tag>. The first two lines are for the declaration of XML and DTD (Document Type Definition). The tag <cpl> means the start of a body of the CPL script. The portion surrounded by <subaction> </subaction> defines a subaction, which is a sub-routine called from the main-routine. <incoming> tag specifies actions activated when an incoming call is received.

Next, <address-switch> allows the CPL to have a conditional branch with respect to the addresses. In this example, the condition is extracted from the host address of the caller (field= "origin" subfield=host). If the host’s domain matches example.com (<address

Figure 1. Behavior of the requirement
3.2 Identical switches with the same parameters (IS)

**Definition:** After a switch tag with a parameter, the same switch with the same parameter comes.

**Effects:** The CPL has no variables or no loop. So, a condition evaluated in the former switch tag never changes in the latter switch tag. Hence, the conditional branch specified in the latter switch is in vain, since the condition must have been evaluated already. This would increase the ambiguity of the CPL script.

**Example CPL:** Figure 4 shows an example. When a call arrives the user, this script will check the originator’s host name. If it matches home.org, the call will be proxied to pattara@home.org. On the other hand, the originator’s host name will be checked again if it matches home.org or not. If yes, this script tries to proxy the call to pattara@mobile.net. But in fact this proxy is never executed. The second switch is redundant and meaningless.

3.3 Call rejection in all paths (CR)

**Definition:** All execution paths terminate at <reject>.

**Effects:** No matter which path is selected, the call is rejected. No call processing is performed, and all executed actions and evaluated conditions are nullified. This is not a problem only when the user wants to reject all calls explicitly. However, complex conditional branches and deeply nested tags will make this problem difficult to be found, on the contrary to user’s intention.

**Example CPL:** Figure 5 shows an example. By this script, any incoming call is rejected, no matter who is the originater: "anonymous", "pattara@example.com" or others. All actions and evaluated conditions are meaningless after all.

3.4 Address set after address switch (AS)

**Definition:** When <address> and <otherwise> tags are specified as outputs of <address-switch>, the same address evaluated in the <address> is set in the <otherwise> block.

**Effects:** The <otherwise> block is executed when the current address does not match the one specified in <address>. If the address is set as a new current address in <otherwise> block, then a violation of the conditional branch might occur. A typical example is that, after screening a specific address by <address-switch>, the call is proxied to the address, although any call to the address must have been filtered.

**Example CPL:** Figure 6 shows an example. When the user make a (outgoing) call, this script will check the destination of the call. The call should be rejected if the destination address is pattara@example.com, according to the condition specified in <address>. However, in the <otherwise> block, the call is proxied to pattara@example.com, which must have been rejected.

3.5 Unused Subactions (US)

**Definition:** Subaction <subaction id= "foo" > exists, but <subaction ref= "foo" > does not.

**Effects:** The subaction is defined but not used. The defined subaction is completely redundant, and should be removed to decrease server’s overhead for parsing the CPL script.
3.6 Overlapped Conditions in Switches (OS)

Definition: The condition is overlapped among the multiple output tags of a switch.

Effects: According to the CPL specification, if there exist multiple output tags for a switch, then the condition is evaluated in the order the tags are presented, and the first tag to match is taken. If the conditions specified in the outputs are overlapped (or identical), then the former tag is always taken. In extreme cases, the latter tag is never executed, which is a redundant description.

Example CPL: Figure 8 shows an example. When a call reaches the subscriber, this script will check the destination of the call. If the destination’s address contains pattara, the call will be proxied to his home telephone address. However, if the destination’s address is pattaraleelaprute, this script tries to proxy the call to his mobile phone. But in fact, if the proxy to pattara has already occurred, proxy to pattaraleelaprute will never occur.

4. Conclusion

In this paper we discussed the six semantic warnings of service descriptions in the CPL: MF, IS, CR, AS, US, OS. Although the evaluation is needed, we believe that the proposed classes contribute to the quality improvement of the programmable service in CPL.

Our primary future work is to apply the proposed classes to the Feature Interaction problem in the Internet telephony, which is known as functional conflicts among multiple services. Also, there could be several other types of warnings to be found. The quantitative evaluation of the proposed classes is important research.

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References


Figure 4. Example of IS

![XML code for IS example]

Figure 5. Example of CR

![XML code for CR example]

Figure 6. Example of AS

![XML code for AS example]

Figure 7. Example of US

![XML code for US example]

Figure 8. Example of OS

![XML code for OS example]