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ONVIF Device Discovery Protocol

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Abstract: When it comes to standardize communication between network devices built by different companies, it is not easy to ensure interoperability between network products. Open Network Video Interface Forum (ONVIF) is an open industry forum which is committed to this task. In implementing the Discovery module, ONVIF devices support WS-Discovery, which is a mechanism that supports probing a network to find ONVIF capable devices. It defines a multicast discovery protocol to locate services. By default, probes are sent to a multicast group, and target services that match return a response directly to the requester. To minimize the need for polling, target services that wish to be discovered send an announcement when they join and leave the network. A successful discovery provides the device service address. Once a client has the device service address it can receive detailed device information through the device service.

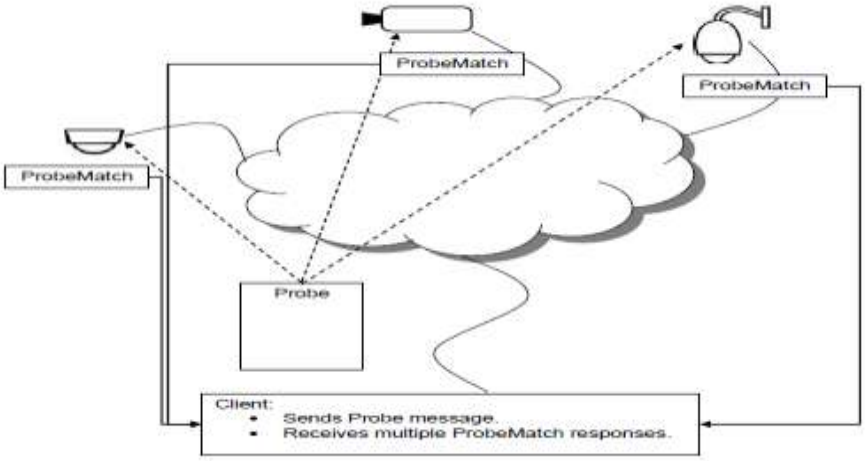
Keywords: ONVIF, WS-Discovery, SOAP, Discovery Proxy.

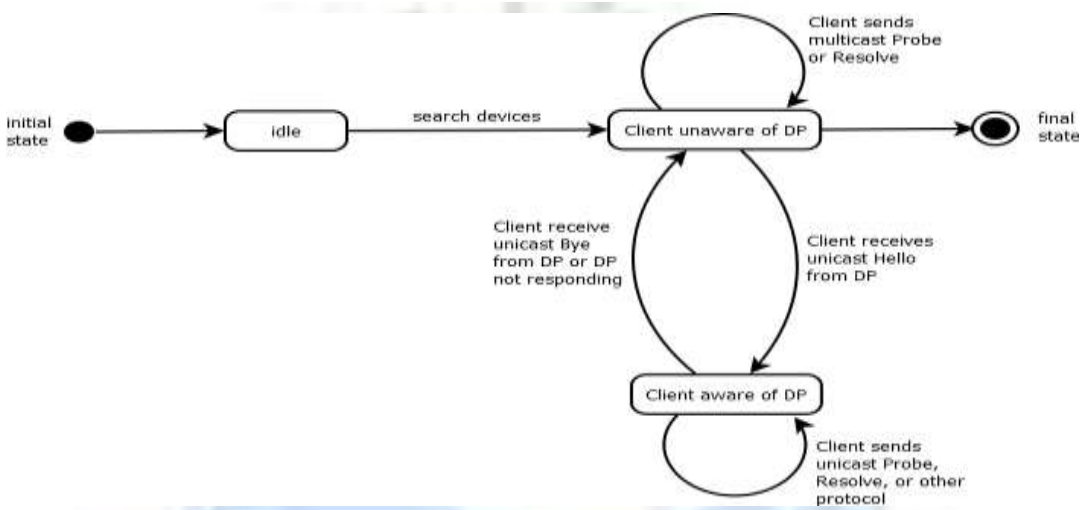
I. Introduction

This paper presents an overview of implementation of ONVIF device Discovery module as an application so as to discover ONVIF devices in a network. This software application will be designed for communication between network clients and devices. This new set of specifications makes it possible to build e.g. network video systems with devices and receivers from different manufacturers using common and well defined interfaces. ONVIF devices support WS-Discovery which enables devices to send Hello messages when they come online to let other devices know they are there. In addition, clients can send Probe messages to find other devices and services on the network. Devices can also send Bye messages to indicate they are leaving the network and going offline. Messages are sent over UDP to a standardized multicast address and UDP port number. All the devices that match the types and scopes specified in the Probe message respond by sending ProbeMatch messages back to the sender. WS-Discovery is normally limited by the network segmentation at a site since the multicast packages typically do not traverse routers. Using a Discovery Proxy that problem could be solved.

II. Overview of Discovery Module

a) The primary mode of discovery is a client searching for one or more target services.
b) To find a target service by the type of the target service, a scope in which the target service resides, or both, a client sends a probe message to a multicast group; target services that match the probe send a response directly to the client.
c) To locate a target service by name, a client sends a resolution request message to the same multicast group, and again, the target service that matches sends a response directly to the client.
d) To scale to a large number of endpoints, this specification defines multicast suppression behavior if a discovery proxy is available on the network.
e) When a discovery proxy detects a probe or resolution request sent by multicast, the discovery proxy sends an announcement for itself. By listening for these announcements, clients detect discovery proxies and switch to use a discovery proxy-specific protocol.
f) If a discovery proxy is unresponsive, clients revert to use the protocol described herein.
g) By default, a new Client assumes that no Discovery Proxy (DP) is available, listens for Hello and Bye announcements, sends Probe and/or Resolve messages, and listens for Probe Match and/or Resolve Match messages.
h) If one or more DP are available, those DP send a unicast Hello with a well-known "discovery proxy" typein response to any multicast Probe or Resolve.
i) Clients listen for this signal that one or more DP are available, and for subsequent searches, Clients do not send Probe and Resolve messages multicast but instead unicast directly to one or more DP whilst ignoring multicast Hello and Bye from Target Services.
j) A Client communicates with a DP using transport information contained in the DP Hello.





III. Mathematical Model

We use the following sets as input and output:
devicetype={x : x is type of desired discoverable device}
devicescope={x : x is service, location,hardware or name of device}
device={(x,y) : x is name of discovered device and y is its capability}

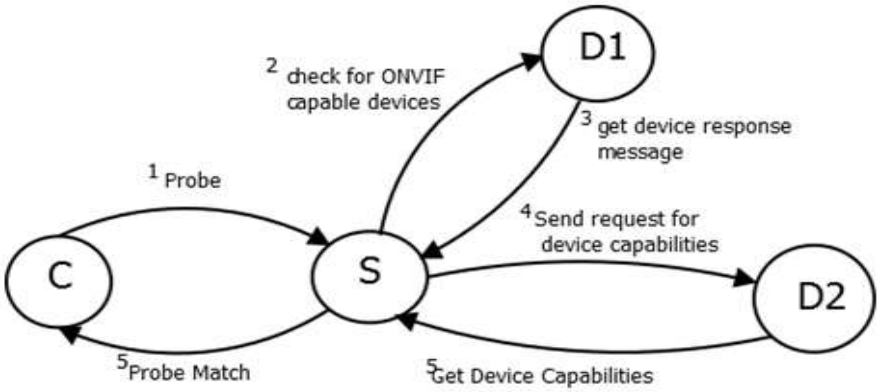


Fig: Graphical representation of probe input, its processing and receiving of probe match as output

Where, C = Client S = Server
D1= Device(s) D2= Database (Server side)

Constraints:

1. Devices should be ONVIF capable devices else they won't be discoverable.
2. The device should be in discoverable mode.

Input to the Device Discovery Module:

Discovery Send Probe (a, b) where, a belongs to set devicetype and b belongs to set device scope.
Output to the Device Discovery Module:
probematch and, probematchlist where, probematch gives the matched device names and probematchlist contains the elements of the set device.

IV. Steps For Implementation

Steps for Discovery module implementation:

Step 1: ONVIF::Discovery- In the Discovery use case, we send a WS-Discovery Probe message and wait for ProbeMatch responses. The responses are processed, and relevant info is stored in a list for processing later. WS-Discovery Probe is sent and the responses are collected and then processed. We wait a while for responses in case data is unavailable or there is timeout. Next probe match is fetched so that it can be put into the probematches list. Information about the matches is stored in the list and checking is done for duplicates.

Step 2: ONVIF::Discovery Send Probe- This function composes and sends a WS-Discovery Probe for the specified scopes and types. Input parameters are:

scopes – The type of services, location, hardware, name, and so on to discover.
types – The device type to discover.

Each probe should have a unique Message ID to be able to match requests and responses. We store it in the probe place holder for later checking. Probe message is then built. Message contains probe Message ID, types and scopes as parameters. Probe is sent to appropriate multicast address and port according to [WS-Discovery].

Step 3: DiscoveryReadResponse- This function reads and processes responses to Probe messages, then updates probematches list. For this we need both the body and header of the response and then we check if it is the response to the probe sent. Then, we pick what we need from the response. Here, XAddrs s a space separated list of URLs to the device service. Probe match is returned in the end.

V. WS-Discovery Protocol Requirements

The following requirements need to be met:

• Allow discovery of services in ad hoc networks with a minimum of networking services (e.g., no DNS or directory services).
• Leverage network services to reduce network traffic in managed networks where such services exist.
• Enable smooth transitions between ad hoc and managed networks.
• Enable discovery of resource-limited service implementations.
• Support bootstrapping to other Web service protocols as well as other transports.
• Enable discovery of services by type and within scope.
• Leverage other Web service specifications for secure, reliable, transacted message delivery.
• Provide extensibility for more sophisticated and/or currently unanticipated scenarios.

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VI. Advantages

a). Division into modules promotes modifiability, scalability.
b) Easy to use Client interface.
c) Timeout is introduced to avoid searching for devices in an infinite loop.

VII. Disadvantages

a) The ONVIF standard is complex to implement and the certification test is insufficient for verifying compatibility between conformant products.
b) ONVIF only specifies how transmission devices must communicate; there is nothing in the standard indicating how or if the receiver (for ex., a video management system) should respond.

c) Using the ONVIF standard is complex to implement and highly demanding on embedded environments.

VIII. Acknowledgment

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IX. Result

An interface on the Client side to discover devices using multicast messages, receive device capabilities and store them. It can also be used to view the video streaming of the discoverable devices from where they are stored.

X. Terminology

Target Service: An endpoint that makes itself available for discovery.

Client: An endpoint that searches for Target Service(s).

Discovery Proxy: An endpoint that facilitates discovery of Target Services by Clients. Discovery Proxies are an optional component of the architecture.

Hello: A message sent by a Target Service when it joins a network; this message contains key information for the Target Service.

Bye: A best-effort message sent by a Target Service when it leaves a network.

Probe: A message sent by a Client searching for a Target Service by Type and/or Scope.

Resolve: A message sent by a Client searching for a Target Service by name.

Type: An identifier for a set of messages an endpoint sends and/or receives.

Scope: An extensibility point that may be used to organize Target Services into logical groups.

XI. References

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