CPE WAN Management Protocol
&
Auto Configuration Server

Who I am

Mi name is Jorge Castellet

I’m Mikrotik certified Trainer.

More than 15 years of experience in networking.

…

Hello, I do no have internet

- The customer communicates with the call center to complain that nothing is working.
- After some checks ... It is determined that the CPE has been restored to factory defaults.

(Of course, he has not touched anything)

You have to go to the client's house to reconfigure the CPE

JORGE CASTELLET MARQUES

Hello, I do no have internet

Everything would be wonderful if my devices were configured by themselves only by plugging them.

If this were possible, I would have more free time.

Wish list ...

- I need a system with which my devices can communicate.
- That is able to identify the devices and send the configuration to each of them.
- I can know if it is configured or not.

Wish granted !

What you need is….

➔CPE WAN Management Protocol (CWMP)

➔Auto Configuration Server (ACS)

CWMP

- TR-069 (Technical Report 069) is a technical specification that defines the application layer for remote management of CPE connected to an IP network.
- The TR-069 standard was developed for automatic configuration and management of devices by Auto Configuration Servers (ACS)

CWMP

- It’s a SOAP/HTTP based protocol.
- Includes:
  - ✔Safe autoconfiguration
  - ✔Control of management functions
- Integrated framework

CWMP

- Session is all the messsages exchanged during a communication.
- Only CPE can initiate a Session.
- CPE starts a Session on different events.
  - For example: first boot, reboot, periodic interval. Transfer complete, diagnostic complete, etc.
- ACS can request to the CPE to start a Session.
- During a session each part call RPC’s to be executed on the other side.
- CPE always start a Session with an Inform RPC, containing connection reason, device info and some extra parameters values.

CWMP

- Parameters are simple name=value pairs
- Each vendor can decide wich parameters to support in its devices.
- Data Model is the combination of all supported parameters.
- There are three root Data Models: TR-098, TR-181:1, TR-181:2
- Vendor must base their supported parameters on root Data Models

What about security ...

TR-069 provides several mechanisms:

- Authentication:
  - ✔Username/password
  - ✔SSL client certificate
- Comunication:
  - ✔SSL
- And you can also implement security on device (like firewall adress list)

Building my own CWMP & ACS

I need to configure:

- CPE:
  - ✔To survive the customer/user
  - ✔To schedule events
- Server:
  - ✔Receive device information
  - ✔Display data
  - ✔Device adoption

CPE

- We need our device to execute a script when it restarts .... easy .. schedule event
- But .. If the client performs a device reset, then all the configuration is deleted, including our scheduled event. How do I solve it?
- I need netinstall to overwrite the default startup script.

CPE

- We overwrite the default startup script to:
- Perform the initial contact with the server, indicating that it is a new device.
- install our script, and schedule it.
- What does our script do?
  - ✔Send keepalive
  - ✔Receive config file and install it
  - ✔Send device status

Server

- I need to build a system with which my device can communicate.
- In order to achieve it, I will need:
  - ➔Apache
  - ➔PHP
  - ➔Mysql

Server

Communicating with CPE:

- ✔ knock.php
- ✔ keepalive.php
- ✔ data.php
- ✔ rpc.php

Knock.php

- It’s called from CPE after an reset or on first boot.
- Insert the new device in pending devices table.
- It’s called periodically until CPE is adopted.
- Available responses:
  - ➔Wait.

    Waiting for human.
  - ➔Rpc.

    Sends a command to CPE.
  - ➔Nothing.

    No business.

Keepalive.php

- This script is called periodically after an adoption.
- It’s called also after a reboot.
- Only send commands to CPE.
- Available response:
  - ➔No

    Unknown device. Wrong place
  - ➔Knock

    Must perform a knock to finish adoption
  - ➔Rpc

    Send a command to CPE
  - ➔Nothing

    No business

Data.php

- This script is called by the CPE to receive the file with the commands it must execute.
- StartAdoption command has a different aproach.
- The file that it returns contains CLI commands that must be executed in the mikrotik.

Rpc.php

- This script is called by the CPE to indicate that it has completed the command that was requested.
- Update the status of the command with the result codes:
  - ✔OK

    The script has been executed correctly.
  - ✔ERROR

    There have been errors in the execution.

    Maybe Syntax error ??

Server

We also need a frontend, in order to:

- ✔ Accept device (adopt)
- ✔ View device status
- ✔ Change device configuration

Discovered.php

- Shows a list of devices that are knocking on the door to enter.

Pending devices Managed devices

Device ID	RouterBoard	RouterOS	Status	Last Seen	Cause	
00:01:02:03:04:06	x86	6.37.4 (bugfix)	Adopting	2018-03-02 03:36:13		
00:0C:29:7B:F0:1B	x86	6.37.4 (bugfix)	Pending	2018-03-16 05:16:29	first boot	Adopt
FA:BA:DA:FA:BA:00	no	6.37.4	Adopting	2018-03-01 01:53:58		

Name: MumMy

Adopt

Pending devices Managed devices

adoption of device 00:0C:29:7B:F0:1B initiated

Device ID	RouterBoard	RouterOS	Status	Last Seen	Cause
00:01:02:03:04:06	x86	6.37.4 (bugfix)	Adopting	2018-03-02 03:36:13	
00:0C:29:7B:F0:1B	x86	6.37.4 (bugfix)	Adopting	2018-03-16 05:16:29	first boot
FA:BA:DA:FA:BA:00	no	6.37.4	Adopting	2018-03-01 01:53:58	

Managed.php

- Shows a list of the adopted devices.
- It also allows us to send commands to the CPE.

Pending devices **Managed devices**

Device ID	RouterBoard	RouterOS	Status	Last Seen	Cause	
00:01:02:03:04:05	x86	6.37.3	Ok	2018-03-15 13:39:20		Send Command
00:01:02:03:04:07	x86	6.37.4 (bugfix)	Ok	2018-03-02 03:59:51		Send Command
00:01:02:03:04:08	x86	6.37.4 (bugfix)	Ok	2018-03-02 04:03:52		Send Command
00:0C:29:7B:F0:1B	x86	6.37.4 (bugfix)	Ok	2018-03-15 17:13:38	periodic	Send Command
FA:BA:DA:FA:BA:DA	x86	6.37.4	Ok	2018-03-01 01:16:23		Send Command

CPE: our beloved mikrotik

- We need a script to perform queries to the server.
- As said before, we need to customize the default mikrotik script to survive the customer/child/wife/husband.
- We will use the same script for the initial contact.

CPE

The script we will use:

- **Knock**

  Performs initial contact requesting server for adoption.

- **Keepalive**

  Once it has been adopted, this script executes the commands from the server.

  It also keeps a heartbeat with the server.

- **Run-keepalive**

  check if we have previously downloaded a new version of the keepalive script

  Of course, it also runs the keepalive script

CPE

I have used other people's functions:

- **UrlEncode**

  Skot

  https://forum.mikrotik.com/viewtopic.php?t=84705

- **GetBetween**

  CuriousKiwi

  https://forum.mikrotik.com/viewtopic.php?t=96172

Knock

```
:local url "http://$username:$password@$acsserver/acs/api/knock.php\?mac=$macaddr&routerboard=$rboard&route
:put $url
do {
/tool fetch url=$url mode=http dst-path="/knock.txt"
:local data [/file get knock.txt contents]
:local status [$getBetween inputString=$data betweenStart="<action>" betweenEnd="</action>"]
if ( $status != "Rpc") do={
:put "nothing to do. I'll check later"
```

```
if ($cmd="StartAdoption") do={
 :local identity [$getBetween inputString=$params betweenStart="<identity>" betweenEnd="</identity>"]
 /system identity set name=$identity
 :set url "http://$username:$password@$acsserver/acs/api/data.php\?mac=$macaddr&id=$id&name=keepalive"
 :put $url
 /tool fetch url=$url mode=http dst-path="/keepalive.rsc"
 :local runstatus
 :do {
   [:parse [/file get keepalive.rsc contents]]
   :set runstatus "Ok"
   /system scheduler disable schedule1
 } on-error={
   :set runstatus "Error"
 `
```


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Keepalive

```
if ($cmd="RunScript") do={
:set url "http://$username:$password@$acsserver/acs/api/data.php\?mac=$macaddr&id=$id&name=keepalive"
:put $url
/tool fetch url=$url mode=http dst-path="/mywork.rsc"
:local runstatus
:do {
  [:parse [/file get mywork.rsc contents]]
  :set runstatus "Ok"
} on-error={
  :set runstatus "Error"
}
:set url "http://$username:$password@$acsserver/acs/api/rpc.php\?mac=$macaddr&id=$id&status=$runstatus"
:put $url
/tool fetch url=$url mode=http dst-path="/rpc.txt"
}
```

OOOOPS

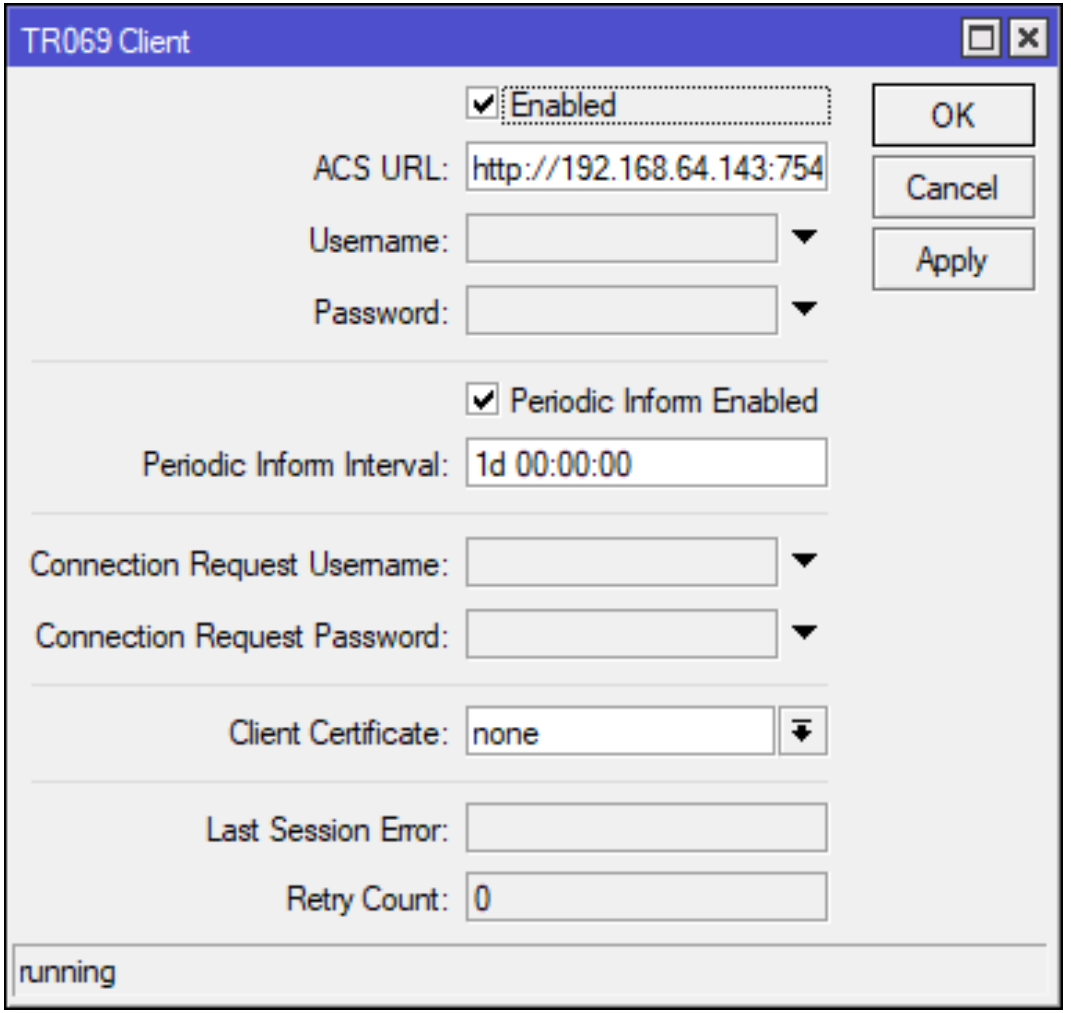
After all the work we have done, ... Mikrotik has implemented the TR-069 client.

So let's use it.

Mikrotik TR-069

- RouterOS implementations supports HTTP or HTTPS on URL of ACS
- Username / password HTTP authentication to “login” into ACS
- Periodic inform
- Client certificate for extra security
- RouterOS Data Model is based on **TR-181 Issue 2 Amendment 11**

Mikrotik TR-069



Mikrotik TR-069

- Unfortunately, after a reset, the tr-069 configuration is also lost
- We still need to use netinstall to survive the customer. ;)
- Our default script, only need to:
  1) Install the ACS certificate (in case of HTTPS communication)
  2) Assign an IP address to a network interface
  3) Configure the client TR-069
- Sample script in:

  https://wiki.mikrotik.com/wiki/Tr069-best-practices

ACS

Mikrotik is compatible with several ACS, for example:

- ✔ AVSystem
- ✔ Axiros
- ✔ Friendly Tech
- ✔ GenieACS (open source)

Genie ACS

- Fast, lightweight TR-069 ACS
- GenieACS is an open source TR-069 remote management solution with advanced device provisioning capabilities.
- Is built with Node.js and uses MongoDB as its database

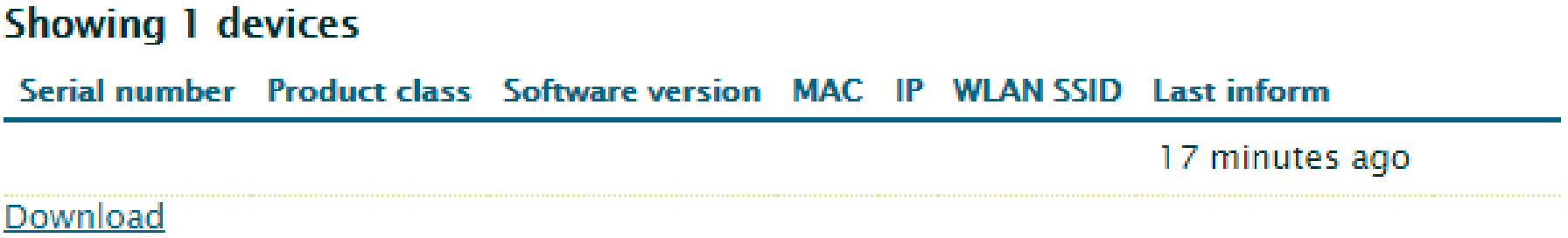
Installation

- We need:
  - ✔Node.js: 6.x and 8.x (8.x recommended)
  - ✔MongoDB: 2.6 through 3.4

- To install Node.js on a Debian/Ubuntu distro you need to download the installation script:
  - ➔setup_8.x
- From:
  - ➔https://deb.nodesource.com

Configuration

- By default GenieACS uses Data model TR-098.
- that means that our devices do not appear correctly in genieacs



Configuration

To solve this, we can modify the files

- ✔genieacs-gui/config/index_parameters.yml
- ✔summary_parameters.yml

Changing:

```
Serial number: InternetGatewayDevice.DeviceInfo.SerialNumber
Product class: InternetGatewayDevice.DeviceInfo.ProductClass
Software version: InternetGatewayDevice.DeviceInfo.SoftwareVersion
```

To:

```
MK Serial number: DeviceInfo.SerialNumber
MK Product class: DeviceInfo.ProductClass
MK Software version: DeviceInfo.SoftwareVersion
```

Configuration

- The best way would be to use a function that returns the undesired values whether it is a mikrotik or another device that follows the TR-098.
- We must use Virtual parameters

  Are user-defined parameters whose values are generated using custom Javascript code.

More information

- https://www.broadband-forum.org/technical/download/TR-069_Amendment-5.pdf
- https://wiki.mikrotik.com/wiki/Manual:TR069-client
- https://wiki.mikrotik.com/wiki/Tr069-best-practices
- https://wiki.mikrotik.com/tr069ref/current.html
- **Hannes Willemse** presentation at ZA17

  https://mum.mikrotik.com/presentations/ZA17/presentation_4990_1512109593.pdf
- https://genieacs.com

More information

If you want the source code, or more information, you can send me an email to:

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