DKT TR-069 implementation, using TR-181 device data model

Introduction
TR-069 (Technical Report 069) is a specification of the CPE WAN Management Protocol (CWMP) developed by the Broadband Forum. It allows for remote management and monitoring of user terminals, such as CPE equipment, by means of HTTP(S) sessions established between the Auto-Configuration Server (ACS) and the CPE. Every session is initiated by the CPE and comprises retrieving and setting the parameters in the device data model. This data model is a hierarchical XML structure, whose objects and elements represent the particular features and services available on the given CPE.

Being a robust and flexible solution, TR-069 may be used to manage not only residential gateways, but also numerous other varieties of network equipment, such as IPTV set-top boxes (STBs), network attached storage (NAS), power line adapters, femtocells, IP phones, and many more.
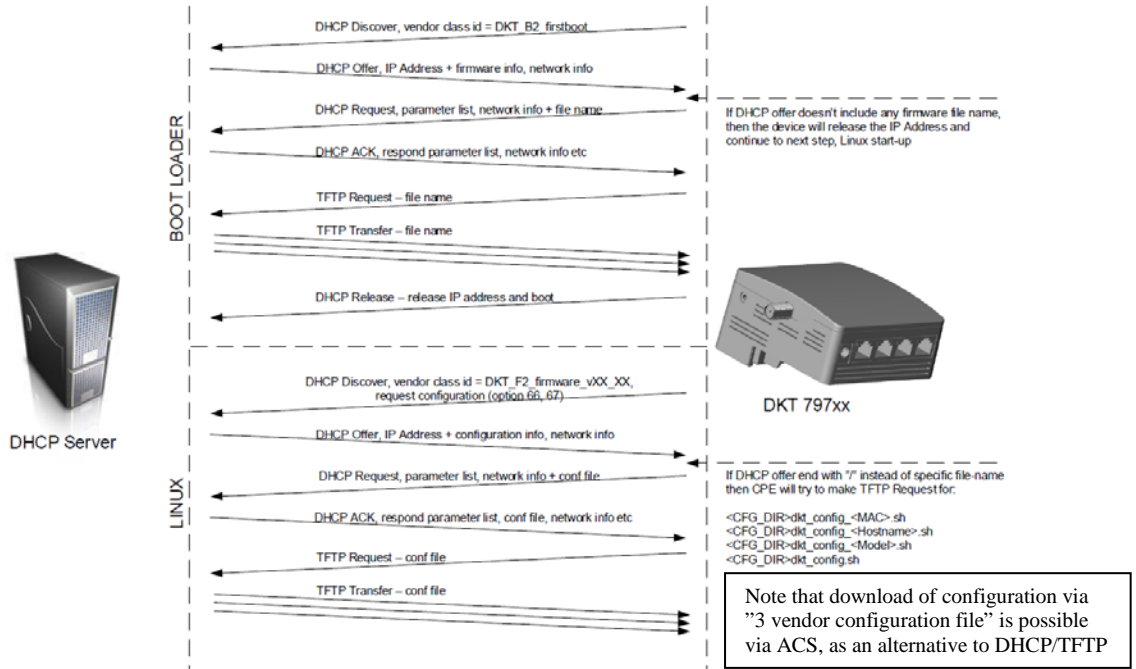
Booting Procedure
The device can be configured with a fixed URL for ACS connectivity (requires special firmware branch), or can obtain its information via DHCP option 43, as outlined in the below DHCP server example.

```
# Encapsulate option space in vendor option (43)
    vendor-option-space                 tr069;
    option tr069.acs-server-url        "http://192.168.10.10:7547/";
    option tr069.provisioning-code      "special-code";
    option tr069.retry-min-wait         "5";
    option tr069.retry-interval-multipl "2000";
```

The device will, if DHCP option 43 parameters are received at boot, automatically start the TR-069 application and make a register towards the ACS.

The standard boot procedure is outlined below.

The DHCP sequence diagram contains the following text:

BOOT LOADER

DHCP Discover, vendor class id = DKT_B2_firstboot

DHCP Offer, IP Address + firmware info, network info

DHCP Request, parameter list, network info + file name

DHCP ACK, respond parameter list, network info etc

TFTP Request – file name

TFTP Transfer – file name

DHCP Release – release IP address and boot

If DHCP offer doesn't include any firmware file name, then the device will release the IP Address and continue to next step, Linux start-up

LINUX

DHCP Discover, vendor class id = DKT_F2_firmware_vXX_XX, request configuration (option 66, 67)

DHCP Offer, IP Address + configuration info, network info

DHCP Request, parameter list, network info + conf file

DHCP ACK, respond parameter list, conf file, network info etc

TFTP Request – conf file

TFTP Transfer – conf file

If DHCP offer end with "/" instead of specific file-name then CPE will try to make TFTP Request for:

<CFG_DIR>dkt_config_<MAC>.sh
<CFG_DIR>dkt_config_<Hostname>.sh
<CFG_DIR>dkt_config_<Model>.sh
<CFG_DIR>dkt_config.sh

Note that download of configuration via "3 vendor configuration file" is possible via ACS, as an alternative to DHCP/TFTP

DHCP Server

DKT 797xx

If no information is received via DHCP option 43, the TR-069 application can be started manually by adding the following to the configuration script

```
# The application can also be started from the configuration script
with the commands:
# alternative 1
enable_tr69
# alternative 2
enable_tr69 <URL> <username> [ <password> [ <URL port> ] ]
# alternative 3
enable_tr69 <Configuration filename>
```

The first command (alternative 1) uses whatever configuration that is stored in flash /mnt/flash/saved_configuration/marm.cfg.

The second command (alternative 2) version specifies the connection request URL on the command line along with the username and password.

The last command (alternative 3) version downloads the configuration file from the TFTP server (using TFTP server information from the DHCP boot procedure) before starting the TR-069 application.

Firmware upgrade

Assuming that the device already has a firmware revision, which is TR-069 aware then if the TR-069 application receives the M Download RPC

method, the firmware will be loaded via HTTP using the received instructions from the ACS Server.
This method is used by the ACS to cause the CPE to download a specified file from the designated location. File type supported by the device is "1 Firmware Upgrade Image" for firmware download

While the download takes place, the TR-069 continues to work as normally. After the firmware has been programmed to the right places, then a `TransferComplete` message is sent to the ACS. When the TR-069 application receives the `TransferCompleteResponse`, and the session has ended, the CPE reboots.

Configuration download

From firmware release *TR-069-05_21 and later* the device supports download of configuration files via ACS, as an alternative to standard DHCP/TFTP option 66/67 method during boot. The configuration script can be executed by performing Download RPC with File type="3 Vendor Configuration File" and putting script file on HTTP/HTTPS server accessible by CPE.

Device Data Model

The following describes the data objects supported with the DKTCOMEGA 797xx CPE series. This is a subset from the TR-181 data model
https://www.broadband-forum.org/cwmp/tr-181-2-9-0.html

```
Device
Device.Bridging
Device.Bridging.Bridge Refresh
Device.Bridging.Bridge.1
Device.Bridging.Bridge.1.Enable true
Device.Bridging.Bridge.1.Port
Device.Bridging.Bridge.1.Port.<n>
Device.Bridging.Bridge.1.Port.<n>.Alias
Device.Bridging.Bridge.1.Port.<n>.Enable
Device.Bridging.Bridge.1.Port.<n>.LowerLayers
Device.Bridging.Bridge.1.Port.<n>.ManagementPort
Device.Bridging.Bridge.1.Port.<n>.Name
Device.Bridging.Bridge.1.Port.<n>.Stats
Device.Bridging.Bridge.1.Port.<n>.Stats.BroadcastPacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.BroadcastPacketsSent
Device.Bridging.Bridge.1.Port.<n>.Stats.BytesReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.BytesSent
Device.Bridging.Bridge.1.Port.<n>.Stats.DiscardPacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.DiscardPacketsSent
Device.Bridging.Bridge.1.Port.<n>.Stats.ErrorsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.ErrorsSent
Device.Bridging.Bridge.1.Port.<n>.Stats.MulticastPacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.MulticastPacketsSent
Device.Bridging.Bridge.1.Port.<n>.Stats.PacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.PacketsSent
Device.Bridging.Bridge.1.Port.<n>.Stats.UnicastPacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Stats.UnicastPacketsSent
```

```
Device.Bridging.Bridge.1.Port.<n>.Stats.UnknownProtoPacketsReceived
Device.Bridging.Bridge.1.Port.<n>.Status
Device.Bridging.Bridge.1.PortNumberOfEntries
Device.Bridging.Bridge.1.Status
Device.Bridging.BridgeNumberOfEntries
Device.Bridging.MaxBridgeEntries
Device.DeviceInfo
Device.DeviceInfo.Description
Device.DeviceInfo.HardwareVersion
Device.DeviceInfo.Manufacturer
Device.DeviceInfo.ManufacturerOUI
Device.DeviceInfo.ModelName
Device.DeviceInfo.ProvisioningCode
Device.DeviceInfo.SerialNumber
Device.DeviceInfo.SoftwareVersion
Device.DeviceInfo.UpTime
Device.Ethernet
Device.Ethernet.Interface
Device.Ethernet.Interface.<n>
Device.Ethernet.Interface.<n>.Alias
Device.Ethernet.Interface.<n>.CurrentBitRate
Device.Ethernet.Interface.<n>.DuplexMode
Device.Ethernet.Interface.<n>.Enable
Device.Ethernet.Interface.<n>.MACAddress
Device.Ethernet.Interface.<n>.MaxBitRate
Device.Ethernet.Interface.<n>.Name
Device.Ethernet.Interface.<n>.Stats
Device.Ethernet.Interface.<n>.Stats.BroadcastPacketsReceived
Device.Ethernet.Interface.<n>.Stats.BroadcastPacketsSent
Device.Ethernet.Interface.<n>.Stats.BytesReceived
Device.Ethernet.Interface.<n>.Stats.BytesSent
Device.Ethernet.Interface.<n>.Stats.DiscardPacketsReceived
Device.Ethernet.Interface.<n>.Stats.DiscardPacketsSent
Device.Ethernet.Interface.<n>.Stats.ErrorsReceived
Device.Ethernet.Interface.<n>.Stats.ErrorsSent
Device.Ethernet.Interface.<n>.Stats.MulticastPacketsReceived
Device.Ethernet.Interface.<n>.Stats.MulticastPacketsSent
Device.Ethernet.Interface.<n>.Stats.PacketsReceived
Device.Ethernet.Interface.<n>.Stats.PacketsSent
Device.Ethernet.Interface.<n>.Stats.UnicastPacketsReceived
Device.Ethernet.Interface.<n>.Stats.UnicastPacketsSent
Device.Ethernet.Interface.<n>.Stats.UnknownProtoPacketsReceived
Device.Ethernet.Interface.<n>.Status
Device.Ethernet.Interface.<n>.Upstream
Device.Ethernet.InterfaceNumberOfEntries
Device.Ethernet.Link
Device.Ethernet.Link.<n>
Device.Ethernet.Link.<n>.Alias
Device.Ethernet.Link.<n>.Enable
Device.Ethernet.Link.<n>.LowerLayers Device.Ethernet.Interface.1
Device.Ethernet.Link.<n>.MACAddress
Device.Ethernet.Link.<n>.Name
Device.Ethernet.Link.<n>.Stats
Device.Ethernet.Link.<n>.Stats.BroadcastPacketsReceived
Device.Ethernet.Link.<n>.Stats.BroadcastPacketsSent
Device.Ethernet.Link.<n>.Stats.BytesReceived
Device.Ethernet.Link.<n>.Stats.BytesSent
Device.Ethernet.Link.<n>.Stats.DiscardPacketsReceived
Device.Ethernet.Link.<n>.Stats.DiscardPacketsSent
Device.Ethernet.Link.<n>.Stats.ErrorsReceived
Device.Ethernet.Link.<n>.Stats.ErrorsSent
Device.Ethernet.Link.<n>.Stats.MulticastPacketsReceived
Device.Ethernet.Link.<n>.Stats.MulticastPacketsSent
Device.Ethernet.Link.<n>.Stats.PacketsReceived
```

```
Device.Ethernet.Link.<n>.Stats.PacketsSent
Device.Ethernet.Link.<n>.Stats.UnicastPacketsReceived
Device.Ethernet.Link.<n>.Stats.UnicastPacketsSent
Device.Ethernet.Link.<n>.Stats.UnknownProtoPacketsReceived
Device.Ethernet.Link.<n>.Status
Device.Ethernet.LinkNumberOfEntries
Device.ManagementServer
Device.ManagementServer.CWMPRetryIntervalMultiplier
Device.ManagementServer.CWMPRetryMinimumWaitInterval
Device.ManagementServer.ConnectionRequestPassword
Device.ManagementServer.ConnectionRequestURL
Device.ManagementServer.ConnectionRequestUsername
Device.ManagementServer.ParameterKey
Device.ManagementServer.Password
Device.ManagementServer.PeriodicInformEnable
Device.ManagementServer.PeriodicInformInterval
Device.ManagementServer.PeriodicInformTime
Device.ManagementServer.URL
Device.ManagementServer.UpgradesManaged
Device.ManagementServer.Username
Device.Optical
Device.Optical.Interface
Device.Optical.Interface.1
Device.Optical.Interface.1.Alias
Device.Optical.Interface.1.Enable
Device.Optical.Interface.1.Name
Device.Optical.Interface.1.OpticalSignalLevel
Device.Optical.Interface.1.Stats
Device.Optical.Interface.1.Stats.BytesReceived
Device.Optical.Interface.1.Stats.BytesSent
Device.Optical.Interface.1.Stats.ErrorsReceived
Device.Optical.Interface.1.Stats.ErrorsSent
Device.Optical.Interface.1.Stats.PacketsReceived
Device.Optical.Interface.1.Stats.PacketsSent
Device.Optical.Interface.1.Status
Device.Optical.Interface.1.TransmitOpticalLevel
Device.Optical.Interface.1.Upstream
Device.Optical.InterfaceNumberOfEntries
Device.Services
summary.hardwareVersion
summary.softwareVersion
```