



APPENDIX **D**

Provisioning API Use Cases

This appendix presents a series of the most common provisioning application programming interface (API) use cases. See the Cisco Broadband Access Center (Cisco BAC) 4.2 API Javadoc for more details and sample Java code segments explaining individual API calls and features.

These use cases are directly related to device provisioning, service provisioning, or both. Many administrative operations, such as managing Class of Service, DHCP Criteria, and licenses are not addressed here. We recommend that you go through the API javadoc for more details on the related API calls. You can also use the administrator user interface to perform most of these activities.

This appendix describes:

- [How to Create an API Client, page D-1](#)
- [Use Cases, page D-4](#)

How to Create an API Client

Before going through the use cases, you must familiarize yourself with how to create an API client. Use the workflow described in this section to create the API client.

Step 1 Create a connection to the Provisioning API Command Engine (PACE).

```
// The PACE connection to use throughout the example. When
// executing multiple batches in a single process, it is advisable
// to use a single PACE connection that is retrieved at the start
// of the application. When done with the connection, YOU MUST
// explicitly close the connection with the releaseConnection()
// method call.

PACEConnection connection = null;

// Connect to the Regional Distribution Unit (RDU).
//
// The parameters defined at the beginning of this class are
// used here to establish the connection. Connections are
// maintained until releaseConnection() is called. If
// multiple calls to getInstance() are called with the same
// arguments, you must still call releaseConnection() on each
// connection you received.
//
// The call can fail for one of the following reasons:
// - The hostname / port is incorrect.
// - The authentication credentials are invalid.
// - The maximum number of allowed sessions for the user
```

```

// has already been reached.

// However, the number of session validation for an user can be
// avoided by using the following overloaded method :
//
// PACEConnectionFactory.getInstance(
//   RDU host      rduHost,
//   RDU port      rduPort,
//   User name     userName,
//   Password      password
//   Is immediate authentication required authenticateImmediately
//   create a session forcefully          forceLogin
// )
try
{
    connection = PACEConnectionFactory.getInstance(

        // RDU host      rduHost,
        // RDU port      rduPort,
        // User name     userName,
        // Password      password);
}
catch (PACEConnectionException e)
{
    // Handle connection error:

    System.out.println("Failed to establish a PACEConnection to [" +
        userName + "@" + rduHost + ":" + rduPort + "]; " +
        e.getMessage());

    System.exit(1);
}

```

Step 2 Create a new instance of a batch.

```

// To perform any operations in the Provisioning API, you must
// first create a batch. As you add commands to the batch,
// nothing gets executed until you post the batch.
// Multiple batches can be started concurrently against a
// single connection to the RDU.

Batch myBatch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

```

Step 3 Register an API command with the batch. The example featured in this step uses the *getDetails(...)* call.

```

// Use the Provisioning API to get all of the information for
// the specified MAC address. Since methods aren't actually
// executed until the batch is posted, the results are not
// returned until after post() completes. The getCommandStatus()
// followed by getData() calls must be used to access the results
// once the batch is posted.

```

```

final DeviceID modemMACAddress = DeviceID.getInstance("1,6,00:11:22:33:44:55",
    KeyType.MAC_ADDRESS);

List options = new ArrayList();
options.add(DeviceDetailsOption.INCLUDE_LEASE_INFO);

myBatch.getDetails(modemMACAddress, options);

```

Step 4 Post the batch to the Regional Distribution Unit (RDU) server.

```

// Executes the batch against the RDU. All of the
// methods are executed in the order entered.

BatchStatus bStatus = null;
try
{
    // Post batch in synchronous fashion without a timeout. This method will block until
    // results are returned. Other API calls are available to submit a batch with timeout
    // or in asynchronous (non-blocking) fashion.

    bStatus = myBatch.post();
}
catch (ProvisioningException pe)
{
    System.out.println("Failed to query for modem with MAC address [" +
        modemMACAddress + "]; " + pe.getMessage());

    System.exit(2);
}

```

Step 5 Check the status of the batch.

```

// Check if any errors occurred during the execution of the
// batch. Exceptions occur during post() for truly exceptional
// situations such as failure of connectivity to RDU.
// Batch errors occur for inconsistencies such as no lease
// information for a device requiring activation. Command
// errors occur when a particular method has problems, such as
// trying to add a device that already exists.

//check batchStatus and commandStatus
//for any error

CommandStatus commandStatus = null;
if (batchStatus.getCommandCount() > 0)
{
    commandStatus = batchStatus.getCommandStatus(0);
}
if (batchStatus.isError()
    || commandStatus == null
    || commandStatus.isError())
{
    System.out.println("Failed to query for modem with MAC address [" +
        modemMACAddress + "]; " + bs.getStatusCode().toString() + ", " +
        bs.getErrorMessage());
    for (int i = 0; i < bs.getCommandCount(); i++)
    {
        CommandStatus cs = bs.getCommandStatus(i);
        System.out.println("Cmd " + i + ": status code "
            + cs.getStatusCode().toString() + ", " + cs.getErrorMessage());
    }
}
}

```

If there is no error, the batch call returns a successful result.

```
// Successfully queried for device.

System.out.println("Queried for DOCSIS modem with MAC address ["+
    modemMACAddress + "]);

// Display the results of the command (TreeMap is sorted). The
// data returned from the batch call is stored on a per-command
// basis. In this example, there is only one command, but if
// you had multiple commands all possibly returning results, you
// could access each result by the index of when it was added.
// The first method added is always index 0. From the status of
// each command, you can then access the accompanying data by
// using the getData() call. Since methods can return data of
// different types, you will have to cast the response to the
// type indicated in the Provisioning API documentation.

Map deviceData = (Map)bStatus.getCommandStatus(0).getData();

// Created a sorted map view

Map<String, Object> deviceDetails = new TreeMap(deviceData);
for(String key: deviceDetails.keySet())
{
    System.out.println(" " + key + "=" + deviceDetails.get(key));
}
```

Step 6 Release the connection.

```
// Once the last batch has been executed, the connection can
// be closed to the RDU. It is important to explicitly
// close connections since it helps ensure clean shutdown of
// the Java virtual machine.

connection.releaseConnection();
```

Use Cases

This section includes these use cases:

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- [Adding a New Computer in Fixed Standard Mode, page D-8](#)
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- [Self-Provisioning First-Time Activation in Promiscuous Mode, page D-20](#)
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Self-Provisioned Modem and Computer in Fixed Standard Mode

The subscriber has a computer installed in a single-dwelling unit and has purchased a DOCSIS cable modem. The computer has a web browser installed.

Desired Outcome

Use this workflow to bring a new unprovisioned DOCSIS cable modem and computer online with the appropriate level of service.

-
- Step 1** The subscriber purchases and installs a DOCSIS cable modem at home and connects a computer to it.
 - Step 2** The subscriber powers on the modem and the computer, and Cisco BAC gives the modem restricted access. The computer and modem are assigned IP addresses from restricted access pools.
 - Step 3** The subscriber starts a web browser, and a spoofing DNS server points the browser to a service provider's registration server (for example, an OSS user interface or a mediator).
 - Step 4** The subscriber uses the service provider's user interface to complete the steps required for registration, including selecting Class of Service.
 - Step 5** The service provider's user interface passes the subscriber's information, such as the selected Class of Service and computer IP address, to Cisco BAC, which then registers the subscriber's modem and computer.

```
// First we query the computer's information to find the
// modem's MAC Address. We use the computer IP Address (the web browser
// received this when the subscriber opened the service provider's
// web interface
```

```
PACEConnection connection = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "changeme");

// NO_ACTIVATION is the activation mode because this is a query.
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device.
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// register getAllForIPAddress to the batch
batch.getAllForIPAddress("10.0.14.38");

BatchStatus batchStatus = null;

// post the batch to RDU server
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
// Get the LeaseResults object after posting a batch.

CommandStatus commandStatus = batchStatus.getCommandStatus(0);

LeaseResults computerLease = (LeaseResults)commandStatus.getData();

// Derive the modem MAC address from computer's network
// information. The "1,6" is a standard prefix for an Ethernet
// device. The fully qualify MAC Address is required by BACC

StringBuffer modemMACAddress = new StringBuffer();
modemMACAddress.append("1,6,");
modemMACAddress.append(computerLease.getSingleLease().get("relay-agent-remote-id"));

// Create MacAddress object from the string

MACAddress modemMACAddressObject = new MACAddress(modemMACAddress.toString());

List<DeviceID> modemDeviceIDList = new ArrayList<DeviceID>();
    modemDeviceIDList.add(modemMACAddressObject);

// Create a new batch to add modem device

batch = connection.newBatch(
```

```

// No reset
ActivationMode.NO_ACTIVATION,

// No need to confirm activation
ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database
PublishingMode.NO_PUBLISHING);

// Register add API to the batch

batch.add(DeviceType.DOCSIS, modemDeviceIDList,
    null, null, "0123-45-6789", "silver", "provisioned-cm", null);

// post the batch to RDU server

// Derive computer MAC address from computer's network information.
String computerMACAddress =
    (String)computerLease.getSingleLease().get(DeviceDetailsKeys.MAC_ADDRESS);

// Create a map for computer property.

Map<String, Object> properties = new HashMap<String, Object>();
properties.put(IPDeviceKeys.MUST_BE_BEHIND_DEVICE, modemMACAddress.toString());

List<DeviceID> compDeviceIDList = new ArrayList<DeviceID>();
MACAddress computerMACAddressObject = new MACAddress(computerMACAddress);
compDeviceIDList.add(computerMACAddressObject);

// Register add API to the batch

batch.add(DeviceType.COMPUTER, compDeviceIDList,
    null, null, "0123-45-6789", null, "provisioned-cpe", properties);
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

```

Step 6 The provisioning client calls *performOperation(DeviceOperation deviceOperation, DeviceID deviceID, Map<String, Object> parameters)* to reboot the modem and gives the modem provisioned access.

```

// Reset the computer
// Create a new batch

batch = connection.newBatch(

    // No reset

    ActivationMode.AUTOMATIC,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// Register performOperation command to the batch

```

```

batch.performOperation(DeviceOperation.RESET, modemMACAddressObject, null);

// Post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

Step 7 The user interface prompts the subscriber to reboot the computer.

After rebooting, the computer receives a new IP address, and both cable modem and computer are now provisioned devices. The computer has access to the Internet through the service provider's network.

Adding a New Computer in Fixed Standard Mode

A multiple system operator (MSO) lets a subscriber have two computers behind a cable modem. The subscriber has one computer already registered and then brings home a laptop from work and wants access. The subscriber installs a hub and connects the laptop to it.

Desired Outcome

Use this workflow to bring a new unprovisioned computer online with a previously provisioned cable modem so that the new computer has the appropriate level of service.

- Step 1** The subscriber powers on the new computer and Cisco BAC gives it restricted access.
- Step 2** The subscriber starts a web browser on the new computer and a spoofing DNS server points it to the service provider's registration server (for example, an OSS user interface or a mediator).
- Step 3** The subscriber uses the service provider's user interface to complete the steps required to add a new computer.
- Step 4** The service provider's user interface passes the subscriber's information, such as the selected Class of Service and computer IP address, to Cisco BAC, which then registers the subscriber's modem and computer.

```

// First we query the computer's information to find the
// modem's MAC Address. We use the computer IP address (the web browser
// received this when the subscriber opened the service provider's
// web interface.
PACEConnection connection = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "changeme");

// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = connection.newBatch(

```



```

// No reset
ActivationMode.NO_ACTIVATION,

// No need to confirm activation
ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database
PublishingMode.NO_PUBLISHING);

// register getAllForIPAddress to the batch
batch.getAllForIPAddress("10.0.14.39");
BatchStatus batchStatus = null;

// post the batch to RDU server
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
// Get the LeaseResults object after posting a batch.

CommandStatus commandStatus = batchStatus.getCommandStatus(0);

LeaseResults computerLease = (LeaseResults)commandStatus.getData();

// derive the modem MAC address from computer's network
// information. The "1,6" is a standard prefix for an Ethernet
// device. The fully qualify MAC Address is required by BACC

StringBuffer modemMACAddress = new StringBuffer();
modemMACAddress.append("1,6,");
modemMACAddress.append(computerLease.getSingleLease().get("relay-agent-remote-id"));

// derive computer MAC address from computer's network information.

String computerMACAddress =
    (String)computerLease.getSingleLease().get(DeviceDetailsKeys.MAC_ADDRESS);

//Create a map for computer property.

Map<String, Object> properties = new HashMap<String, Object>();

// setting IPDeviceKeys.MUST_BE_BEHIND_DEVICE on the computer ensures
// that when the computer boots, it will only receive its provisioned
// access when it is behind the given device. If it is not behind
// the given device, it will receive default access (unprovisioned)
// and hence fixed mode.

properties.put(IPDeviceKeys.MUST_BE_BEHIND_DEVICE, modemMACAddress);

// the IPDeviceKeys.MUST_BE_IN_PROV_GROUP ensures that the computer
// will receive its provisioned access only when it is brought up in
// the specified provisioning group. This prevents the computer
// (and/or) the modem from moving from one locality to another
// locality.

```

```

properties.put(IPDeviceKeys.MUST_BE_IN_PROV_GROUP, "bostonProvGroup");

List<DeviceID> compDeviceIDList = new ArrayList<DeviceID>();
MACAddress computerMACAddressObject = new MACAddress(computerMACAddress);
compDeviceIDList.add(computerMACAddressObject);

batch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// register add API to the batch

batch.add(
    DeviceType.COMPUTER,    // deviceType: Computer
    compDeviceIDList,      // compDeviceIDList: the list of DeviceIDs derived from
                           // computerLease
    null,                  // hostName: not used in this example
    null,                  // domainName: not used in this example
    "0123-45-6789",       // ownerName
    null,                  // class of service: get the default COS
    "provisionedCPE",     // dhcpCriteria: Network Registrar uses this to
                           // select a modem lease granting provisioned IP address
    properties             // device properties
);

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

Step 5 The user interface prompts the subscriber to reboot the new computer so that Cisco BAC can give the computer its registered service level.

The computer is now a provisioned device with access to the appropriate level of service.

Disabling a Subscriber

A service provider needs to disable a subscriber from accessing the Internet due to recurring nonpayment.

Desired Outcome

Use this workflow to disable an operational cable modem and computer, so that the devices temporarily restrict Internet access for the user. Additionally, this use case can redirect the user's browser to a special page that could announce:

You haven't paid your bill so your Internet access has been disabled.

-
- Step 1** The service provider's application uses a provisioning client program to request a list of all of the subscriber's devices from Cisco BAC.
- Step 2** The service provider's application then uses a provisioning client to individually disable or restrict each of the subscriber's devices.

```

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

//get all for owner ID

Batch batch = conn.newBatch();
batch.getAllForOwnerID("0123-45-6789");

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(Exception e)
{
    e.printStackTrace();
}
CommandStatus commandStatus = batchStatus.getCommandStatus(0);

//batch success without error, retrieve the result

RecordSearchResults rcSearchResult = (RecordSearchResults)commandStatus.getData();
List<RecordData> resultList = rcSearchResult.getRecordData();

if (resultList != null)
{
    // getting the data

    for (int i=0; i<resultList.size(); i++)
    {
        RecordData rd = resultList.get(i);
        Map<String, Object> detailMap = rd.getDetails();

        //get the deviceType from the detail map

        String deviceType =
            (String)detailMap.get(DeviceDetailsKeys.DEVICE_TYPE);

        Key primaryKey = rd.getPrimaryKey();

        //only interest in DOCSIS
        if (DeviceType.getDeviceType(deviceType)

```

```

        .equals(DeviceType.DOCSIS)
    {
        //change COS

        batch = conn.newBatch();
        batch.changeClassOfService((DeviceID)primaryKey, "DisabledCOS");

        //change DHCPCriteria

        batch.changeDHCPCriteria((DeviceID)primaryKey, "DisabledDHCPCriteria");

        batchStatus = null;
        try
        {
            batchStatus = batch.post();
        }
        catch(Exception e)
        {
            e.printStackTrace();
        }
    }
    //disable computer

    else if (DeviceType.getDeviceType(deviceType)
        .equals(DeviceType.COMPUTER))
    {
        //change DHCPCriteria

        batch = conn.newBatch();
        batch.changeClassOfService((DeviceID)primaryKey,
            "DisabledComputerCOS");
        batch.changeDHCPCriteria((DeviceID)primaryKey,
            "DisabledComputerDHCPCriteria");

        batchStatus = null;
        try
        {
            batchStatus = batch.post();
        }
        catch(Exception e)
        {
            e.printStackTrace();
        }
    }
}

```

**Note**

You may need to consider the impact on the CPE behind the modem when defining the characteristics of DisabledCOS and resetting the modem. This is especially important if you have voice end points behind the modem, because disrupting the cable modem might affect the telephone conversation in progress at that time.

The subscriber is now disabled.

Preprovisioning Modems/Self-Provisioned Computers

A new subscriber contacts the service provider and requests service. The subscriber has a computer installed in a single-dwelling unit. The service provider preprovisions all its cable modems in bulk.

Desired Outcome

Use this workflow to bring a preprovisioned cable modem, and an unprovisioned computer, online in the roaming standard mode. This must be done so that both devices have the appropriate level of service and are registered.

-
- Step 1** The service provider chooses a subscriber username and password for the billing system.
 - Step 2** The service provider selects services that the subscriber can access.
 - Step 3** The service provider's field technician installs the physical cable to the new subscriber's house and installs the preprovisioned device, connecting it to the subscriber's computer.
 - Step 4** The technician turns on the modem and Cisco BAC gives it a provisioned IP address.
 - Step 5** The technician turns on the computer and Cisco BAC gives it a private IP address.
 - Step 6** The technician starts a browser application on the computer and points the browser to the service provider's user interface.
 - Step 7** The technician accesses the service provider's user interface to complete the steps required for registering the computer behind the provisioned cable modem.

```
// First we query the computer's information to find the
// modem's MAC Address. We use the computer IP address (the web browser
// received this when the subscriber opened the service provider's
// web interface

PACEConnection connection = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "changeme");

// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// register getAllForIPAddress to the batch

batch.getAllForIPAddress("10.0.14.38");

BatchStatus batchStatus = null;

// post the batch to RDU server
```

```

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

// Get the LeaseResults object after posting a batch.

CommandStatus commandStatus = batchStatus.getCommandStatus(0);

LeaseResults computerLease = (LeaseResults)commandStatus.getData();

// derive computer MAC address from computer's network information.
String computerMACAddress =
    (String)computerLease.getSingleLease().get(DeviceDetailsKeys.MAC_ADDRESS);

    List<DeviceID> compDeviceIDList = new ArrayList<DeviceID>();
    MACAddress computerMACAddressObject = new MACAddress(computerMACAddress);
    compDeviceIDList.add(computerMACAddressObject);

// NO_ACTIVATION will generate new configuration for the computer,
// however it will not attempt to reset it.
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the computer because this cannot be done.

batch = connection.newBatch(
    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// register add API to the batch

batch.add(
    DeviceType.COMPUTER, // deviceType: Computer
    compDeviceIDList, // compDeviceIDList: the list of DeviceIDs derived from
    // computerLease
    null, // hostName: not used in this example
    null, // domainName: not used in this example
    "0123-45-6789", // ownerName
    null, // class of service: get the default COS
    "provisionedCPE", // dhcpCriteria: Network Registrar uses this to
    // select a modem lease granting provisioned IP address
    null // properties: not used
);

// post the batch to RDU server

try
{
    batchStatus = batch.post();

```

```

    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
}

```

**Note**

The *IPDeviceKeys.MUST_BE_BEHIND_DEVICE* property is not set on the computer and this allows roaming from behind one cable modem to another.

Step 8

The technician restarts the computer and the computer receives a new provisioned IP address.

The cable modem and the computer are now both provisioned devices. The computer has access to the Internet through the service provider's network.

Modifying an Existing Modem

A service provider's subscriber currently has a level of service known as **Silver** and has decided to upgrade to **Gold** service. The subscriber has a computer installed at home.

**Note**

The intent of this use case is to show how to modify a device. You can apply this example to devices provisioned in modes other than roaming standard.

Desired Outcome

Use this workflow to modify an existing modem's Class of Service and pass that change of service to the service provider's external systems.

Step 1

The subscriber phones the service provider and requests to have service upgraded. The service provider uses its user interface to change the Class of Service from **Silver** to **Gold**.

Step 2

The service provider's application makes these API calls in Cisco BAC:

```

// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// replace changeClassOfService to this. Make sure the comment
// on top of this line is still there.

```

```

batch.changeClassOfService(new MACAddress("1,6,00:11:22:33:44:55")

    // the MACAddress object

    , "Gold");

// post the batch to the RDU

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

The subscriber can now access the service provider's network with the *Gold* service.

Unregistering and Deleting a Subscriber's Devices

A service provider needs to delete a subscriber who has discontinued service.

Desired Outcome

Use this workflow to permanently remove all the subscriber's devices from the service provider's network.

- Step 1** The service provider's user interface discontinues service to the subscriber.
- Step 2** This step describes how to unregister a subscriber's device and delete a subscriber's device. Deleting a device is optional because some service providers prefer to keep the cable modem in the database unless it is broken. Note however that if you unregister a device using Step 2-a, you cannot delete the device using Step 2-b.
- a. To unregister a device, the service provider's application uses a provisioning client program to request a list of all the subscriber's devices from Cisco BAC, and unregisters and resets each device so that it is brought down to the default (unprovisioned) service level.



Note If the device specified as the parameter to the "unregister" API is already in unregistered state then the status code from the API call will be set to `CommandStatusCodes.CMD_ERROR_DEVICE_UNREGISTERED_ERROR`. This is normal/expected behavior.

```

// MSO admin UI calls the provisioning API to get a list of
// all the subscriber's devices.

// Create a new connection

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

```



```
// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

batch.getAllForOwnerID("0123-45-6789"

// query all the devices for this account number
);

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(Exception e)
{
    e.printStackTrace();
}
CommandStatus commandStatus = batchStatus.getCommandStatus(0);

//batch success without error, retrieve the result

RecordSearchResults rcSearchResult = (RecordSearchResults)commandStatus.getData();
List<RecordData> resultList = rcSearchResult.getRecordData();

// We need to unregister all the devices behind each modem(s) or else the
// unregister call for that modem will fail.

if (resultList != null)
{
    //Unregister the COMPUTER
    for (int i=0; i<resultList.size(); i++)
    {
        RecordData rd = resultList.get(i);
        Map<String, Object> detailMap = rd.getDetails();

        //get the deviceType from the detail map

        String deviceType = (String)detailMap.get(DeviceDetailsKeys.DEVICE_TYPE);

        //only interest in DOCSIS

        if (DeviceType.getDeviceType(deviceType) .equals(DeviceType.COMPUTER))
        {
```

```

        Key primaryKey = rd.getPrimaryKey();

        batch = conn.newBatch();
        batch.unregister((DeviceID)primaryKey);

        batchSize = null;
        try
        {
            batchSize = batch.post();
        }
        catch(ProvisioningException e)
        {
            e.printStackTrace();
        }
    }
}

// for each modem in the retrieved list:

for (int i=0; i<resultList.size(); i++)
{
    RecordData rd = resultList.get(i);
    Map<String, Object> detailMap = rd.getDetails();

    //get the deviceType from the detail map

    String deviceType = (String)detailMap.get(DeviceDetailsKeys.DEVICE_TYPE);

    //only interest in DOCSIS

    if (DeviceType.getDeviceType(deviceType) .equals(DeviceType.DOCSIS))
    {
        Key primaryKey = rd.getPrimaryKey();
        batch = conn.newBatch();
        batch.unregister((DeviceID)primaryKey);
        batchSize = null;
        try
        {
            batchSize = batch.post();
        }
        catch(ProvisioningException e)
        {
            e.printStackTrace();
        }
    }
}
}

```

- b.** To delete a device, the service provider's application uses a provisioning client program to delete each of the subscriber's remaining devices individually from the database.

```

// Create a new connection

PACEConnection conn =
    PACEConnectionFactory.getInstance("localhost", 49187, "admin", "admin123");

// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

Batch batch = conn.newBatch(

```

```

// No reset
ActivationMode.NO_ACTIVATION,

// No need to confirm activation
ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database
PublishingMode.NO_PUBLISHING);

batch.getAllForOwnerID("0123-45-6789" // query all the devices for this account
// number
);

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(Exception e)
{
    e.printStackTrace();
}

CommandStatus commandStatus = batchStatus.getCommandStatus(0);

//batch success without error, retrieve the result

RecordSearchResults rcSearchResult = (RecordSearchResults)commandStatus.getData();
List<RecordData> resultList = rcSearchResult.getRecordData();

if (resultList != null)
{

// for each modem in the retrieved list, delete it

for (int i=0; i<resultList.size(); i++)
{
    RecordData rd = resultList.get(i);
    Map<String, Object> detailMap = rd.getDetails();

//get the deviceType from the detail map

String deviceType = (String)detailMap.get(DeviceDetailsKeys.DEVICE_TYPE);

//only interest in DOCSIS

if (DeviceType.getDeviceType(deviceType) .equals(DeviceType.DOCSIS))
{
    Key primaryKey = rd.getPrimaryKey();

//change COS

batch = conn.newBatch();
batch.delete((DeviceID)primaryKey, true);

batchStatus = null;
try
{

```

```

        batchStatus = batch.post();
    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
}
}
}

```

Self-Provisioning First-Time Activation in Promiscuous Mode

The subscriber has a computer (with a browser application) installed in a single-dwelling unit and has purchased a DOCSIS cable modem.

Desired Outcome

Use this workflow to bring a new unprovisioned DOCSIS cable modem and computer online with the appropriate level of service.

-
- Step 1** The subscriber purchases a DOCSIS cable modem and installs it at home.
 - Step 2** The subscriber powers on the modem, and Cisco BAC gives it restricted access.
 - Step 3** The subscriber starts a browser application on the computer and a spoofing DNS server points the browser to the service provider's registration server (for example, an OSS user interface or a mediator).
 - Step 4** The subscriber uses the service provider's user interface to complete the steps required for registration, including selecting a Class of Service.

The service provider's user interface passes the subscriber's information to Cisco BAC, including the selected Class of Service and computer IP address. The subscriber's cable modem and computer are then registered with Cisco BAC.

- Step 5** The user interface prompts the subscriber to reboot the computer.

```

// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// NO_ACTIVATION is the activation mode because this is a
// query. NO_CONFIRMATION is the confirmation mode because
// we are not attempting to reset the device.

```

```
// First we query the computer's information to find the
// modem's MAC address.
// We use the computer's IP address (the web browser
// received this when the subscriber opened the service
// provider's web interface).
// We also assume that "bostonProvGroup"
// is the provisioning group used in that locality.

List<String> provGroupList = new ArrayList<String>();

provGroupList.add("bostonProvGroup");

batch.getAllForIPAddress("10.0.14.38",

    // ipAddress: restricted access computer lease
    provGroupList
    // provGroups: List containing provgroup
    );

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

// Get the LeaseResults object after posting a batch.

CommandStatus commandStatus = batchStatus.getCommandStatus(0);

LeaseResults computerLease = (LeaseResults)commandStatus.getData();

// Derive the modem MAC address from the computer's network
// information. The 1,6, is a standard prefix for an Ethernet
// device. The fully qualified MAC address is required by BACC

StringBuffer modemMACAddress = new StringBuffer();
modemMACAddress.append("1,6,");
modemMACAddress.append(computerLease.getSingleLease().get("relay-agent-remote-id"));

//create MacAddress object from the string

MACAddress modemMACAddressObject = new MACAddress(modemMACAddress.toString());

List<DeviceID> modemDeviceIDList = new ArrayList<DeviceID>();
modemDeviceIDList.add(modemMACAddressObject);

// NO_ACTIVATION is the activation mode because this is a query
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the device
// NO_PUBLISHING is the publishing mode because we are not attempting
// to publish to external database.

batch = conn.newBatch(
```

```

// No reset

ActivationMode.NO_ACTIVATION,

// No need to confirm activation

ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database

PublishingMode.NO_PUBLISHING);

Map<String, Object> properties = new HashMap<String, Object>();

// Set the property PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED
// to enable promiscuous mode on modem

properties.put(PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED, Boolean.TRUE);

properties.put(PolicyKeys.COMPUTER_DHCP_CRITERIA, "provisionedCPE");

// enable promiscuous mode by changing the technology default

batch.changeDefaults(DeviceType.DOCSIS,
    properties, null);

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

batch = conn.newBatch(

// No reset

ActivationMode.NO_ACTIVATION,

// No need to confirm activation

ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database

PublishingMode.NO_PUBLISHING);

batch.add(
    DeviceType.DOCSIS, // deviceType: DOCSIS
    modemDeviceIDList, // macAddress: derived from computer lease
    null, // hostName: not used in this example
    null, // domainName: not used in this example
    "0123-45-6789", // ownerID: here, account number from billing system
    "Silver", // ClassOfService
    "provisionedCM", // DHCP Criteria: Network Registrar uses this to
    // select a modem lease granting provisioned IP address
    null // properties:
);

```

Step 6 The provisioning client calls *performOperation(...)* to reboot the modem and gives the modem provisioned access.

```
// Reset the computer
// create a new batch
batch = conn.newBatch(

    // No reset

    ActivationMode.AUTOMATIC,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// register performOperation command to the batch

batch.performOperation(DeviceOperation.RESET,
    modemMACAddressObject, null);

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}
```

Step 7 When the computer is rebooted, it receives a new IP address.

The cable modem is now a provisioned device. The computer is not registered with Cisco BAC, but it gains access to the Internet through the service provider's network. Computers that are online behind promiscuous modems are still available using the provisioning API.

Bulk Provisioning 100 Modems in Promiscuous Mode

A service provider wants to preprovision 100 cable modems for distribution by a customer service representative at a service kiosk.

Desired Outcome

Use this workflow to distribute modem data for all modems to new subscribers. The customer service representative has a list of modems available for assignment.

-
- Step 1** The cable modem's MAC address data for new or recycled cable modems is collected into a list at the service provider's loading dock.
 - Step 2** Modems that are assigned to a particular kiosk are bulk-loaded into Cisco BAC and are flagged with the identifier for that kiosk.
 - Step 3** When the modems are distributed to new subscribers at the kiosk, the customer service representative enters new service parameters, and changes the Owner ID field on the modem to reflect the new subscriber's account number.

```
// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// The activation mode for this batch should be NO_ACTIVATION.
// NO_ACTIVATION should be used in this situation because no
// network information exists for the devices because they
// have not booted yet. A configuration can't be generated if no
// network information is present. And because the devices
// have not booted, they are not online and therefore cannot
// be reset. NO_CONFIRMATION is the confirmation mode because
// we are not attempting to reset the devices.
// Create a Map for the properties of the modem

Map properties;

// Set the property PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED to
// enable promiscuous mode on modem.
// This could be done at a system level if promiscuous mode
// is your default provisioning mode.

properties.put(PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED, Boolean.TRUE);

// The PolicyKeys.CPE_DHCP_CRITERIA is used to specify the DHCP
// Criteria to be used while selecting IP address scopes for
// CPE behind this modem in the promiscuous mode.

properties.put(PolicyKeys.COMPUTER_DHCP_CRITERIA, "provisionedCPE");

// enable promiscuous mode by changing the technology default

batch.changeDefaults(DeviceType.DOCSIS,properties, null);

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

// for each modem MAC-address in list:
```



```

ModemLoop:
{
    batch = conn.newBatch(

        // No reset

        ActivationMode.NO_ACTIVATION,

        // No need to confirm activation

        ConfirmationMode.NO_CONFIRMATION,

        // No publishing to external database

        PublishingMode.NO_PUBLISHING);

    batch.add(
        DeviceType.DOCSIS, // deviceType: DOCSIS
        modemMACAddressList, // modemMACAddressList: the list of deviceID
        null, // hostName: not used in this example
        null, // domainName: not used in this example
        "0123-45-6789", // ownerID: here, account number from billing system
        "Silver", // ClassOfService
        "provisionedCM", // DHCP Criteria: Network Registrar uses this to
        // select a modem lease granting provisioned IP address
        properties // properties:
    );

    try
    {
        batchStatus = batch.post();
    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
    // end ModemLoop.
}

```

Preprovisioning First-Time Activation in Promiscuous Mode

A new subscriber contacts the service provider and requests service. The subscriber has a computer installed in a single-dwelling unit.

Desired Outcome

Use this workflow to bring a new unprovisioned cable modem and computer online with the appropriate level of service.

-
- Step 1** The service provider chooses a subscriber username and password for the billing system.
 - Step 2** The service provider selects the services that the subscriber can access.
 - Step 3** The service provider registers the device using its own user interface.

- Step 4** The service provider's user interface passes information, such as the modem's MAC address and the Class of Service, to Cisco BAC. Additionally, the modem gets a CPE DHCP Criteria setting that lets Network Registrar select a provisioned address for any computers to be connected behind the modem. The new modem is then registered with Cisco BAC.
- Step 5** The service provider's field technician installs the physical cable to the new subscriber's house and installs the preprovisioned device, connecting it to the subscriber's computer.

```
// MSO admin UI calls the provisioning API to pre-provision
// an HSD modem.

// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// The activation mode for this batch should be NO_ACTIVATION.
// NO_ACTIVATION should be used in this situation because no
// network information exists for the modem because it has not
// booted. A configuration cannot be generated if no network
// information is present. And because the modem has not booted,
// it is not online and therefore cannot be reset.
// NO_CONFIRMATION is the confirmation mode because we are not
// attempting to reset the modem.
// Create a map for the properties of the modem.

Map<String, Object> properties = new HashMap<String, Object>();

// Set the property PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED
// to enable promiscuous mode on modem

properties.put(PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED, Boolean.TRUE);

properties.put(PolicyKeys.COMPUTER_DHCP_CRITERIA, "provisionedCPE");

// enable promiscuous mode by changing the technology default

batch.changeDefaults(DeviceType.DOCSIS, properties, null);

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
```

```

    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
    batch = conn.newBatch(

        // No reset

        ActivationMode.NO_ACTIVATION,

        // No need to confirm activation

        ConfirmationMode.NO_CONFIRMATION,

        // No publishing to external database

        PublishingMode.NO_PUBLISHING);

    MACAddress macAddressObject = new MACAddress("1,6,00:11:22:33:44:55");
    List<DeviceID> modemDeviceIDList = new ArrayList<DeviceID>();
    modemDeviceIDList.add(macAddressObject);

    batch.add(
        DeviceType.DOCSIS,          // deviceType: DOCSIS
        modemDeviceIDList,         // macAddress: derived from computer lease
        null,                       // hostName: not used in this example
        null,                       // domainName: not used in this example
        "0123-45-6789",            // ownerID: here, account number from billing system
        "Silver",                  // ClassOfService
        "provisionedCM",          // DHCP Criteria: Network Registrar uses this to
                                // select a modem lease granting provisioned IP address
        null                        // properties:
    );

    // post the batch to RDU server

    try
    {
        batchStatus = batch.post();
    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
}

```

Step 6 The technician powers on the cable modem and Cisco BAC gives it provisioned access.

Step 7 The technician powers on the computer and Cisco BAC gives it provisioned access.

The cable modem and the computer are now both provisioned devices. The computer has access to the Internet through the service provider's network.

Replacing an Existing Modem

A service provider wants to replace a broken modem.



Note

If the computer has the option restricting roaming from one modem to another, and the modem is replaced, the computer's MAC address for the modem must also be changed.

Desired Outcome

Use this workflow to physically replace an existing cable modem with a new modem without changing the level of service provided to the subscriber.

Step 1 The service provider changes the MAC address of the existing modem to that of the new modem.

```
// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

MACAddress macAddressObject = new MACAddress("1,6,00:11:22:33:44:55");
List<DeviceID> modemDeviceIDList = new ArrayList<DeviceID>();
modemDeviceIDList.add(macAddressObject);

// old macAddress: unique identifier for the old modem
MACAddress oldMacAddress = new MACAddress("1,6,00:11:22:33:44:55");

// new macAddress: unique identifier for the new modem
MACAddress newMacAddress = new MACAddress("1,6,00:11:22:33:44:66");
List<DeviceID> newDeviceIDs = new ArrayList<DeviceID>();
newDeviceIDs.add(newMacAddress);

batch.changeDeviceID(oldMacAddress, newDeviceIDs);

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}
```

Step 2 The service provider replaces the cable modem and turns it on.

- Step 3** The computer must also be turned on.
- The cable modem is now a fully provisioned device with the appropriate level of service, as is the computer behind the cable modem.
-

Adding a Second Computer in Promiscuous Mode

A subscriber wants to connect a second computer behind an installed cable modem. This case does not require calls to the provisioning API.

Desired Outcome

Use this workflow to ensure that the subscriber's selected service permits the connection of multiple sets of CPE, and that the subscriber has network access from both connected computers.

- Step 1** The subscriber connects a second computer behind the cable modem.
- Step 2** The subscriber turns on the computer.
- If the subscriber's selected service permits connecting multiple sets of CPE, Cisco BAC gives the second computer access to the Internet.
-

Self-Provisioning First-Time Activation with NAT

A university has purchased a DOCSIS cable modem with network address translation (NAT) and DHCP capability. The five occupants of the unit each have a computer installed with a browser application.

Desired Outcome

Use this workflow to bring a new unprovisioned cable modem (with NAT) and the computers behind it online with the appropriate level of service.

- Step 1** The subscriber purchases a cable modem with NAT and DHCP capability and installs it in a multiple-dwelling unit.
- Step 2** The subscriber turns on the modem and Cisco BAC gives it restricted access.
- Step 3** The subscriber connects a laptop computer to the cable modem, and the DHCP server in the modem provides an IP address to the laptop.
- Step 4** The subscriber starts a browser application on the computer and a spoofing DNS server points the browser to the service provider's registration server (for example, an OSS user interface or a mediator).
- Step 5** The subscriber uses the service provider's user interface to complete the steps required for cable modem registration of the modem. The registration user interface detects that the modem is using NAT and registers the modem, making sure that the modem gets a Class of Service that is compatible with NAT. For details, see [Self-Provisioned Modem and Computer in Fixed Standard Mode, page D-5](#).

**Note**

Certain cable modems with NAT may require you to reboot the computer to get the new Class of Service settings. If the cable modem and NAT device are separate devices, the NAT device must also be registered similarly to registering a computer.

Adding a New Computer Behind a Modem with NAT

The landlord of an apartment building has four tenants sharing a modem and accessing the service provider's network. The landlord wants to provide Internet access to a new tenant, sharing the building's modem. The modem has NAT and DHCP capability. The new tenant has a computer connected to the modem.

**Note**

This case does not require calls to the provisioning API.

Desired Outcome

Use this workflow to bring a new unprovisioned computer online with a previously provisioned cable modem so that the new computer has the appropriate level of service.

Step 1 The subscriber turns on the computer.

Step 2 The computer is now a provisioned device with access to the appropriate level of service.
The provisioned NAT modem hides the computers behind it from the network.

Move Device to Another DHCP Scope

A service provider is renumbering its network causing a registered cable modem to require an IP address from a different Network Registrar scope.

Desired Outcome

A provisioning client changes the DHCP Criteria, and the cable modem receives an IP address from the corresponding DHCP scope.

Step 1 Change the DOCSIS modem's DHCP Criteria to "newmodemCriteria".

```
// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.AUTOMATIC,

    // No need to confirm activation
```

```

ConfirmationMode.NO_CONFIRMATION,

// No publishing to external database

PublishingMode.NO_PUBLISHING);

// AUTOMATIC is the Activation mode because we are attempting
// to reset the modem so that a phone line is disabled
// NO_CONFIRMATION is the Confirmation mode because we don't
// want the batch to fail if we can't reset the modem.
// This use case assumes that the DOCSIS modem has been
// previously added to the database

batch.changeDHCPCriteria(
    new MACAddress("1,6,ff:00:ee:11:dd:22"), // Modem's MAC address or FQDN
    "newmodemCriteria"
);

// post the batch to RDU server

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

Step 2 The modem gets an IP address from the scope targeted by “newmodemCriteria.”

Log Device Deletions Using Events

A service provider has multiple provisioning clients and wants to log device deletions.

Desired Outcome

When any provisioning client deletes a device, the provisioning client logs an event in one place.

Step 1 Create a listener for the device deletion event. This class must extend the *DeviceAdapter* abstract class or, alternatively, implement the *DeviceListener* interface. This class must also override the *deletedDevice(DeviceEvent ev)* method in order to log the event.

```

public DeviceDeletionLogger
    extends DeviceAdapter

    //Extend the DeviceAdapter class.
{
    public void deletedDevice(DeviceEvent ev)

    //Override deletedDevice.
    {
        logDeviceDeletion(ev.getDeviceID());

        //Log the deletion.
    }
}

```

```
}

```

Step 2 Register the listener and the qualifier for the events using the *PACEConnection* interface.

```
DeviceDeletionLogger deviceDeletionLogger =
    new DeviceDeletionLogger();

    // Modem's MAC address or FQDN "newmodemCriteria"

DeviceEventQualifier qualifier = new DeviceEventQualifier();

// We are interested only in device deletion.

qualifier.setDeletedDevice ();

// Add device listener using PACEConnection

connection.addDeviceListener(deviceDeletionLogger, qualifier
);
```

Step 3 When a device is deleted from the system, the event is generated, and the listener is notified.

Monitoring an RDU Connection Using Events

A service provider is running a single provisioning client and wants notification if the connection between the provisioning client and the RDU breaks.

Desired Outcome

Use this workflow to have the event interface notify the service provider if the connection breaks.

Step 1 Create a listener for the messaging event. This class must extend the *MessagingAdapter* abstract class or, alternatively, implement the *MessagingListener* interface. This class must override the *connectionStopped(MessagingEvent ev)* method.

```
// Extend the service provider's Java program using the
// provisioning client to receive Messaging events.
public MessagingNotifier
    extends MessagingAdapter

    //Extend the MessagingAdapter class.
{
    public void connectionStopped(MessagingEvent ev)

    //Override connectionStopped.
    {
        doNotification(ev.getAddress(), ev.getPort());

        //Do the notification.
    }
}
```

Step 2 Register the listener and the qualifier for the events using the *PACEConnection* interface.

```
MessagingQualifier qualifier =new MessagingQualifier();
qualifier.setConnectionDown();
MessagingNotifier messagingNotifier = new MessagingNotifier();
connection.addMessagingListener(messagingNotifier, qualifier
);
```


- Step 3** If a connection breaks, the event is generated, and the listener is notified. Whenever connectivity is interrupted, the PACE Connection automatically reconnects to the RDU.
-

Logging Batch Completions Using Events

A service provider has multiple provisioning clients and wants to log batch completions.

Desired Outcome

When any provisioning client completes a batch, an event is logged in one place.

- Step 1** Create a listener for the event. This class must extend the *BatchAdapter* abstract class or implement the *BatchListener* interface. This class must override the *completion(BatchEvent ev)* method in order to log the event.

```
public BatchCompletionLogger
    extends BatchAdapter

    //Extend the BatchAdapterclass.
{
    public void completion(BatchEvent ev)
        //Override completion.
    {
        logBatchCompletion(ev.BatchStatus().getBatchID());
        //Log the completion.
    }
}
```

- Step 2** Register the listener and the qualifier for the events using the *PACEConnection* interface.

```
BatchCompletionLogger batchCompletionLogger = new BatchCompletionLogger();
BatchEventQualifier qualifier = new BatchEventQualifier();
connection.addBatchListener(batchCompletionLogger , qualifier
);
```

- Step 3** When a batch completes, the event is generated, and the listener is notified.
-

Getting Detailed Device Information

A service provider wants to allow an administrator to view detailed information for a particular device.

Desired Outcome

The service provider's administrative application displays all known details about a given device, including MAC address, lease information, provisioned status of the device, and the device type (if known).

- Step 1** The administrator enters the MAC address for the device being queried into the service provider's administrator user interface.

- Step 2** Cisco BAC queries the embedded database for the device details.

```
// The host name or IP address of the RDU. It is
```

```
// recommended that you normally use a fully-qualified domain name
// since it lends itself to the greatest flexibility going forward.
// For example, you could change the host running RDU without
// having to reassign IPs. For that reason, having an alias for
// the machine is better than a specific name.

final String rduHost = "localhost";

// The port number of RDU on the server.

final int rduPort = 49187;

// The user name for connecting to RDU.

final String userName = "admin";

// The password to use with the username.

final String password = "changeme";

// -----
// DEVICE PARAMETERS, see IPDevice.getDetails()
// -----

// The MAC address of the modem to be queried. MAC addresses in BAC
// must follow the simple "1,6,XX:XX:XX:XX:XX:XX" format.

final DeviceID modemMACAddress = DeviceID.getInstance("1,6,00:11:22:33:44:55",
    KeyType.MAC_ADDRESS);

// The PACE connection to use throughout the example. When
// executing multiple batches in a single process, it is advisable
// to use a single PACE connection that is retrieved at the start
// of the application. When done with the connection, YOU MUST
// explicitly close the connection with the releaseConnection()
// method call.

PACEConnection connection = null;

// 1) Connect to the Regional Distribution Unit (RDU).
//
// The parameters defined at the beginning of this class are
// used here to establish the connection. Connections are
// maintained until releaseConnection() is called. If
// multiple calls to getInstance() are called with the same
// arguments, you must still call releaseConnection() on each
// connection you received.
//
// The call can fail for one of the following reasons:
// - The hostname / port is incorrect.
// - The authentication credentials are invalid.
// - The maximum number of allowed sessions for the user
// has already been reached.
try
{
    connection = PACEConnectionFactory.getInstance(
        // RDU host    rduHost,
        // RDU port    rduPort,
        // User name   userName,
        // Password    password
    );
}
catch (PACEConnectionException e)
{

```

```
// failed to get a connection

System.out.println("Failed to establish a PACEConnection to [" +
    userName + "@" + rduHost + ":" + rduPort + "]; " +
    e.getMessage());

System.exit(1);
}
// 2) Create a new batch instance.
//
// To perform any operations in the Provisioning API, you must
// first start a batch. As you make commands against the batch,
// nothing will actually start until you post the batch.
// Multiple batches can be started concurrently against a
// single connection to the RDU.

Batch myBatch = connection.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// 3) Register the getDetails(...) with the batch.

// Use the Provisioning API to get all of the information for
// the specified MAC address. Since methods aren't actually
// executed until the batch is posted, the results are not
// returned until after post() completes. The getCommandStatus()
// followed by getData() calls must be used to access the results
// once the batch is posted.

final DeviceID modemMACAddress = DeviceID.getInstance("1,6,00:11:22:33:44:55",
    KeyType.MAC_ADDRESS);

List options = new ArrayList();
    options.add(DeviceDetailsOption.INCLUDE_LEASE_INFO);

myBatch.getDetails(modemMACAddress, options);

// 4) Post the batch to the server.
//
// Executes the batch against the RDU. All of the
// methods are executed in the order entered and the data
// changes are applied against the embedded database in RDU.

BatchStatus bStatus = null;
try
{
    bStatus = myBatch.post();
}
catch (ProvisioningException pe)
{
    System.out.println("Failed to query for modem with MAC address [" +
        modemMACAddress + "]; " + pe.getMessage());
}

System.exit(2);
```

```

}
// 5) Check to see if the batch was successfully posted.
//
// Verify if any errors occurred during the execution of the
// batch. Exceptions occur during post() for truly exception
// situations such as failure of connectivity to RDU.
// Batch errors occur for inconsistencies such as no lease
// information for a device requiring activation. Command
// errors occur when a particular method has problems, such as
// trying to add a device that already exists.

if (bStatus.isError())
{
// Batch error occurred.

System.out.println("Failed to query for modem with MAC address [" +
    modemMACAddress + "]; " + bStatus.getErrorMessage());

System.exit(3);
}

```

- Step 3** The service provider's application presents a page of device data details, which can display everything that is known about the requested device. If the device was connected to the service provider's network, this data includes lease information (for example, IP address and relay agent identifier). The data indicates whether the device was provisioned, and if it was, the data also includes the device type.

```

// Successfully queried for device.
System.out.println("Queried for DOCSIS modem with MAC address [" +
    modemMACAddress + "]);

// Display the results of the command (TreeMap is sorted). The
// data returned from the batch call is stored on a per-command
// basis. In this example, there is only one command, but if
// you had multiple commands all possibly returning results, you
// could access each result by the index of when it was added.
// The first method added is always index 0. From the status of
// each command, you can then access the accompanying data by
// using the getData() call. Since methods can return data of
// different types, you will have to cast the response to the
// type indicated in the Provisioning API documentation.

Map<String, Object> deviceDetails = new HashMap<String,
    Object>(Map)bStatus.getCommandStatus(0).getData();

String deviceType = (String)deviceDetails.get(DeviceDetailsKeys.DEVICE_TYPE);
String macAddress = (String)deviceDetails.get(DeviceDetailsKeys.MAC_ADDRESS);
String fqdn = (String)deviceDetails.get(DeviceDetailsKeys.FQDN);
String duid = (String)deviceDetails.get(DeviceDetailsKeys.DUID);
String host = (String)deviceDetails.get(DeviceDetailsKeys.HOST);
String domain = (String)deviceDetails.get(DeviceDetailsKeys.DOMAIN);

// if the device is DocsisModem, get the COS

String cos = (String)deviceDetails.get(DeviceDetailsKeys.CLASS_OF_SERVICE);
String dhcpCriteria = (String)deviceDetails.get(DeviceDetailsKeys.DHCP_CRITERIA);
String provGroup = (String)deviceDetails.get(DeviceDetailsKeys.PROV_GROUP);
Boolean isProvisioned = (Boolean)deviceDetails.get(DeviceDetailsKeys.IS_PROVISIONED);
String ownerID = (String)deviceDetails.get(DeviceDetailsKeys.OWNER_ID);
Boolean isRegistered = (Boolean)deviceDetails.get(DeviceDetailsKeys.IS_REGISTERED);
String oidNumber = (String)deviceDetails.get(GenericObjectKeys.OID_REVISION_NUMBER);

// if the device is a modem, get the device behind

```

```

String relayAgentMacAddress =
    (String)deviceDetails.get(DeviceDetailsKeys.RELAY_AGENT_MAC);
String relayAgentDUID = (String)deviceDetails.get(DeviceDetailsKeys.RELAY_AGENT_DUID);

// get the map of Device property

Map deviceProperties = (Map)deviceDetails.get(DeviceDetailsKeys.PROPERTIES);

// get the map of discovery data v4

Map dhcpdiscovermapv4 =
    (Map)deviceDetails.get(DeviceDetailsKeys.DISCOVERED_DATA_DHCPV4);

// if discovery data is not null, get the inform, response, request and environment
// map from discovery data map

Map dhcpInformMap = (Map)dhcpdiscovermapv4.get("INFORM");
Map dhcpRespMap = (Map)dhcpdiscovermapv4.get("RESPONSE");
Map dhcpReqMap = (Map)dhcpdiscovermapv4.get("REQUEST");
Map dhcpEnvMap = (Map)dhcpdiscovermapv4.get("ENVIRONMENT");

// get the map of lease query v4

Map leasemapv4 = (Map)deviceDetails.get(DeviceDetailsKeys.LEASE_QUERY_DATA_DHCPV4);
String leaseTime = (String)leasemapv4.get(CNRNames.DHCP_LEASE_TIME.toString());
String rebindingTime =
    (String)leasemapv4.get(CNRNames.DHCP_REBINDING_TIME.toString());

String clientLastTransTime =
    (String)leasemapv4.get(CNRNames.CLIENT_LAST_TRANSACTION_TIME.toString());
String clientIPAddress= (String)leasemapv4.get(CNRNames.CLIENT_IPADDRESS.toString());
String relayAgentRemoteID=
    (String)leasemapv4.get(CNRNames.RELAY_AGENT_REMOTE_ID.toString());
String relayAgentCircuitID=
    (String)leasemapv4.get(CNRNames.RELAY_AGENT_CIRCUIT_ID.toString());

// get the map of discovery DHCP v6

Map dhcpdiscovermapv6 =
    (Map)deviceDetails.get(DeviceDetailsKeys.DISCOVERED_DATA_DHCPV6);

// if discovery data is not null , get the inform, response, request and environment
// map from discovery data map

Map dhcpv6InformMap = (Map)dhcpdiscovermapv6.get("INFORM");

Map dhcpv6RespMap = (Map)dhcpdiscovermapv6.get("RESPONSE");

Map dhcpv6ReqMap = (Map)dhcpdiscovermapv6.get("REQUEST");

Map dhcpv6RelReqMap = (Map)dhcpdiscovermapv6.get("RELAY_REQUEST");

Map dhcpv6EnvMap = (Map)dhcpdiscovermapv6.get("ENVIRONMENT");

// get the map of lease query V6

Map leasemapv6 = (Map)deviceDetails.get(DeviceDetailsKeys.LEASE_QUERY_DATA_DHCPV6);

String iaprefixkey = (String)leasemapv6.get(CNRNames.IAPREFIX.toString());
String iaaddrkey = (String)leasemapv6.get(CNRNames.IAADDR.toString());
String leasetimev6 = (String)leasemapv6.get(CNRNames.VALID_LIFETIME.toString());
String renewalttimev6 = (String)leasemapv6.get(CNRNames.PREFERRED_LIFETIME.toString());
String dhcplasttranstimev6 =
    (String)leasemapv6.get(CNRNames.CLIENT_LAST_TRANSACTION_TIME);

```

```
String clientIpAddressV6 = (String)leaseMapV6.get(CNRNames.CLIENT_IPADDRESS);
String relayAgentRemoteIdV6 = (String)leaseMapV6.get(CNRNames.RELAY_AGENT_REMOTE_ID);
String relayAgentCircuitIdV6 =
    (String)leaseMapV6.get(CNRNames.RELAY_AGENT_CIRCUIT_ID);
```

Searching Using the Device Type

A service provider wants to allow an administrator to view data for all DOCSIS modems.

Desired Outcome

The service provider's administrative application returns a list of DOCSIS devices.

- Step 1** The administrator selects the search option in the service provider's administrator user interface.
- Step 2** Cisco BAC queries the embedded database for a list of all MAC addresses for the DOCSIS modems.

```
public static void getAllDevicesByDeviceType() throws Exception {
    DeviceSearchType dst = DeviceSearchType.getByDeviceType(
        DeviceType.getDeviceType(DeviceTypeValues.DOCSIS_MODEM),
        ReturnParameters.ALL);

    RecordSearchResults rs = null;

    SearchBookmark sb = null;

    rs = searchDevice(dst, sb);
    sb = rs.getSearchBookmark();

    while (sb != null)
    {
        // print out the data in the record search result.
        sb = printRecordSearchResults(rs);

        // call the search routine again
        rs = searchDevice(dst, sb);
    }
}

private static RecordSearchResults searchDevice(DeviceSearchType dst,
        SearchBookmark sb) throws Exception {
    RecordSearchResults rs = null;
    final Batch batch = s_conn.newBatch();
    final int numberOfRecordReturn = 10;

    //calling the search API
    batch.searchDevice(dst, sb, numberOfRecordReturn);

    // Call the RDU.
    BatchStatus batchStatus = batch.post();

    // Check for success.
    CommandStatus commandStatus = null;

    if (0 < batchStatus.getCommandCount())
    {
        commandStatus = batchStatus.getCommandStatus(0);
    }
    //check to see if there is an error
    if (batchStatus.isError())
```

```
    || batchSize.isWarning()
    || commandStatus == null
    || commandStatus.isError()
    {
        System.out.println("report batch error.");
        return null;
    }

    //batch success without error, retrieve the result
    //this is a list of devices
    rs = (RecordSearchResults)commandStatus.getData();
    return rs;
}

private static SearchBookmark printRecordSearchResults(RecordSearchResults rs) throws
Exception {

    SearchBookmark sb = rs.getSearchBookmark();

    List<RecordData> rdlist = rs.getRecordData();
    Iterator<RecordData> iter = rdlist.iterator();

    while (iter.hasNext())
    {
        RecordData rdObj = iter.next();
        Key keyObj = rdObj.getPrimaryKey();

        System.out.println("DeviceOID: " + ((DeviceID)keyObj).getDeviceId());

        //this is for secondary keys.
        List<Key> deviceList = rdObj.getSecondaryKeys();

        if (deviceList != null && !deviceList.isEmpty())
        {
            for (int i=0; i<deviceList.size(); i++)
            {
                Key key = deviceList.get(i);
                System.out.println("DeviceID : " + key.toString());
            }
        }
    }
    return sb;
}
```

Searching for Devices Using Vendor Prefix or Class of Service

A service provider wants to allow an administrator to search for all devices matching a particular vendor prefix or a particular Class of Service.

Desired Outcome

The service provider's administrative application returns a list of devices matching the requested vendor prefix or the Class of Service.

-
- Step 1** The administrator enters the substring matching the desired vendor prefix into the service provider's administrator user interface.
- Step 2** Cisco BAC queries the embedded database for a list of all MAC addresses for the devices that match the requested vendor prefix or Class of Service. This example illustrates how you can build the search query to retrieve devices using the MAC address. Also see [Searching Using the Device Type, page D-38](#).

```
DeviceIDPattern pattern = new MACAddressPattern("1,6,22:49:*");

DeviceSearchType dst = DeviceSearchType.getDevices(pattern, ReturnParameters.ALL);

// To set up search for class of service:

DeviceSearchType searchType = DeviceSearchType.getByClassOfService(
    new ClassOfServiceName(name), AssociationType
    .valueOf(association), ReturnParameters.ALL);
```

- Step 3** The service provider's application requests details on these devices from Cisco BAC, and presents a page of device data. For each device, the code displays the device type, MAC address, client class, and provisioned status of the device. One device is identified per line.

```
// calling the search procedure

rs = searchDevice(connection, dst, sb);
sb = processRecordSearchResults(rs);

if (rs != null)
{
    while (sb != null)
    {
        // The search returns a search bookmark, which can be used to make
        // the next search call that would return next set of results

        rs = searchDevice(connection, dst, sb);
        sb = processRecordSearchResults(rs);
    }
}
}
```

Preprovisioning PacketCable eMTA

A new customer contacts a service provider to order PacketCable voice service. The customer expects to receive a provisioned embedded MTA.

Desired Outcome

Use this workflow to preprovision an embedded MTA so that the modem MTA component has the appropriate level of service when brought online.



Note

This use case skips the call agent provisioning that is required for making telephone calls from eMTAs.

Step 1 The service provider chooses a subscriber username and password for the billing system.

Step 2 The service provider chooses the appropriate Class of Service and DHCP Criteria for the modem component and adds it to Cisco BAC.

```
// Create a new connection

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// Let's provision the modem and the MTA component in the same
// batch. This can be done because the activation mode of this
// batch is NO_ACTIVATION. More than one device can be operated
// on in a batch if the activation mode does not lead to more
// than one device being reset.
// To add a DOCSIS modem:

List<DeviceID> modemDeviceIDList = new ArrayList<DeviceID>();
modemDeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:06"));
batch.add(
    DeviceType.DOCSIS,           // deviceType: DOCSIS
    modemDeviceIDList,         // macAddress: scanned from the label
    null,                       // hostName: not used in this example
    null,                       // domainName: not used in this example
    "0123-45-6789",            // ownerID: here, account number from billing system
    "Silver",                  // classOfService
    "provisionedCM",           // DHCP Criteria: Network Registrar uses this to
                                // select a modem lease granting provisioned IP address
    null                       // properties: not used
);
```

Step 3 The service provider chooses the appropriate Class of Service and DHCP Criteria for the MTA component and adds it to Cisco BAC.

```
List<DeviceID> packetcableMTADeviceIDList = new ArrayList<DeviceID>();
packetcableMTADeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:07"));
```

```

// Continuation of the batch in Step2
// To add the MTA component:

batch.add(
    DeviceType.PACKET_CABLE_MTA, // deviceType: PACKET_CABLE_MTA
    packetcableMTADeviceIDList, // macAddress: scanned from the label
    null, // hostName: not used in this example, will be auto
        // generated
    null, // domainName: not used in this example, will be
        // auto generated. The FqdnKeys.AUTO_FQDN_DOMAIN
        // property must be set somewhere in the property
        // hierarchy.
    "0123-45-6789", // ownerID: here, account number from billing system
    "Silver", // ClassOfService
    "provisionedMTA", // DHCP Criteria: Network Registrar uses this to
        // select an MTA lease granting provisioned IP
        // address
    null // properties: not used
);

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

Step 4 The embedded MTA gets shipped to the customer.

Step 5 The customer brings the embedded MTA online and makes telephone calls using it.

SNMP Cloning on PacketCable eMTA

An administrator wants to grant SNMP Element Manager access to a PacketCable eMTA.

Desired Outcome

An external Element Manager is granted secure SNMPv3 access to the PacketCable eMTA.



Note

Changes made to RW MIB variables are not permanent and are not updated in the Cisco BAC configuration for the eMTA. The information written into the eMTA MIB is lost the next time the MTA powers down or resets.

Step 1 Call the provisioning API method, *performOperation(...)*, passing in the MAC address of the MTA and the username of the new user to create on the MTA. This will be the username used in subsequent SNMP calls by the Element Manager.

```

// Create a new connection
PACEConnection conn = PACEConnectionFactory.getInstance(

```

```

        "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// NO_ACTIVATION is the activation mode because we don't want to
// reset the device.
// NO_CONFIRMATION is the confirmation mode because we are
// not attempting to reset the device.
// The goal here is to create a new user on the MTA indicated
// by the MAC address. The other parameter needed here is the new
// user name, which is passed in the Map.
// Create a map that contains one element - the name of
// the new user to be created on the MTA

HashMap<String, Object> map = new HashMap<String, Object>();
map.put( SNMPPPropertyKeys.CLONING_USERNAME, "newUser" );

// The first param is the actual device operation to perform.

batch.performOperation(
    DeviceOperation.ENABLE_SNMPV3_ACCESS,    // deviceOperation : ENABLE_SNMPV3_ACCESS
    new MACAddress("1,6,00:00:00:00:00:99"), // macORFqdn : MAC Address of the modem
    map                                       // parameters: operation specific
                                           // parameters
);

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

- Step 2** The provisioning API attempts to perform an SNMPv3 cloning operation to create an entry on the MTA for the new user passed in Step 1. The keys used in the new user entry row are a function of two passwords defined within Cisco BAC. These passwords will be made available to the customer and the RDU command passes these passwords (the auth and priv password) through a key localization algorithm to create an auth and priv key. These are stored, along with the new user, in the eMTA's user table.



Note The auth and priv passwords mentioned in this step may be changed by setting `SNMPPPropertyKeys.CLONING_AUTH_PASSWORD` (*/snmp/cloning/auth/password*) and `SNMPPPropertyKeys.CLONING_PRIV_PASSWORD` (*/snmp/cloning/priv/password*) properties, respectively, in the *rdm.properties* configuration file.

- Step 3** The customer issues SNMPv3 requests using the specified username, passwords, and key localization algorithm to allow for secure communication with the MTA.

Incremental Provisioning of PacketCable eMTA

A customer has a PacketCable eMTA in service with its first line (end point) enabled. The customer wants to enable the second telephone line (end point) on the eMTA and connect a telephone to it.

Desired Outcome

The customer should be able to connect a telephone to the second line (end point) on the eMTA and successfully make phone calls from it without any service interruption.



Note

In order to use the second line on the eMTA, the Call Agent needs to be configured accordingly. This use case does not address provisioning of call agents.

- Step 1** The service provider's application invokes the Cisco BAC API to change the Class of Service of the eMTA. The new Class of Service supports two end points on the eMTA. This change in Class of Service does not take effect until the eMTA is reset. Disrupting the eMTA is not desirable; therefore, incremental provisioning is undertaken in the next step.

```
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// NO_ACTIVATION is the activation mode because we don't want to
// reset the device.
// NO_CONFIRMATION is the Confirmation mode because we are not
// disrupting the device.

batch.changeClassOfService(
    new MACAddress("1,6,ff:00:ee:11:dd:22"), / eMTA's MAC address or FQDN
    "twoLineEnabledCOS" // This COS supports two lines.
);
BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
```

Step 2 The service provider's application uses the Cisco BAC incremental update feature to set SNMP objects on the eMTA and thereby enabling the service without disrupting the eMTA.

```
// The goal here is to enable a second phone line, assuming one
// phone line is currently enabled. We will be adding a new
// row to the pktcNcsEndPntConfigTable.

batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// NO_ACTIVATION is the activation mode because we don't want to
// reset the device.
// NO_CONFIRMATION is the confirmation mode because we are
// not attempting to reset the device.
// Create a map containing one element - the list of SNMP
// variables to set on the MTA

HashMap<String, Object> map = new HashMap<String, Object>();

// Create an SnmpVarList to hold SNMP varbinds

SnmpVarList list = new SnmpVarList();

// An SnmpVariable represents an oid/value/type triple.
// pktcNcsEndPntConfigTable is indexed by the IfNumber, which in this case we will
// assume is interface number 12 (this is the last number in each of the oids below).
// The first variable represents the creation of a new row in
// pktcNcsEndPntConfigTable we are setting the RowStatus
// column (column number 26). The value of 4 indicates that
// a new row is to be created in the active state.

SnmpVariable variable = new SnmpVariable( ".1.3.6.1.4.1.4491.2.2.2.1.2.1.1.26.12",
    "4", SnmpType.INTEGER );
list.add( variable );

// The next variable represents the call agent id for this new
// interface, which we'll assume is 'test.com'

variable = new SnmpVariable( ".1.3.6.1.4.1.4491.2.2.2.1.2.1.1.1.12", "test.com",
    SnmpType.STRING );
list.add( variable );

// The final variable represents the call agent port

variable = new SnmpVariable( ".1.3.6.1.4.1.4491.2.2.2.1.2.1.1.2.12", "2728",
    SnmpType.INTEGER );
list.add( variable );

// Add the SNMP variable list to the Map to use in the API call

map.put( SNMPPropertyKeys.SNMPVAR_LIST, list );

// Invoke the BACC API to do incremental update on the eMTA.

batch.performOperation(
    DeviceOperation.INCREMENTAL_UPDATE, // device operation
    new MACAddress("1,6,00:00:00:00:00:99"), // MAC Address
```

```

        map                                     // Parameters for the operation
    );

    // post the batch to RDU server

    try
    {
        batchStatus = batch.post();
    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
}

```

- Step 3** The eMTA is enabled to use the second telephone line. The eMTA continues to receive the same service, after being reset, because the Class of Service was changed in Step 1.
-

Preprovisioning DOCSIS Modems with Dynamic Configuration Files

A new customer contacts a service provider to order a DOCSIS modem with high-speed *Gold* data service for two sets of CPE behind it.

Desired Outcome

Use this workflow to preprovision a DOCSIS modem with a Class of Service that uses DOCSIS templates. The dynamic configuration file generated from the templates is used while the modem comes online.

- Step 1** The service provider chooses a subscriber username and password for the billing system.
- Step 2** The service provider chooses Gold Class of Service, and the appropriate DHCP Criteria, and then adds the cable modem to Cisco BAC.

```

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

Map<String, Object> properties = new HashMap<String, Object>();

// Set the property PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED to enable
// promiscuous mode on modem

properties.put(PolicyKeys.COMPUTER_PROMISCUOUS_MODE_ENABLED, Boolean.TRUE);

// enable promiscuous mode by changing the technology default

batch.changeDefaults(DeviceType.DOCSIS,properties, null);

```

```

BatchStatus batchStatus = null;

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
// No CPE DHCP Criteria is specified.
// The CPE behind the modem will use the default provisioned
// promiscuous CPE DHCP criteria specified in the system defaults.
// This custom property corresponds to a macro variable in the
// DOCSIS template for "gold" class of service indicating the
// maximum number of CPE allowed behind this modem. We set it
// to two sets of CPE from this customer.

properties = new HashMap<String, Object>();
properties.put("docsis-max-cpes", "2");

batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// To add a DOCSIS modem:

List<DeviceID> deviceIDList = new ArrayList<DeviceID>();
deviceIDList.add(new MACAddress("1,6,01:02:03:04:05:06"));
batch.add(
    DeviceType.DOCSIS,        // deviceType: DOCSIS
    deviceIDList,            // macAddress: scanned from the label
    null,                    // hostName: not used in this example
    null,                    // domainName: not used in this example
    "0123-45-6789",         // ownerID: here, account number from billing system
    "gold",                  // classOfService:
    "provisionedCM",        // DHCP Criteria: Network Registrar uses this to
                            // select a modem lease granting provisioned IP address
    properties               // properties:
);

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

- Step 3** The cable modem is shipped to the customer.
- Step 4** The customer brings the cable modem online and connects the computers behind it.
-

Optimistic Locking

An instance of the service provider application needs to ensure that it is not overwriting the changes made by another instance of the same application.

Desired Outcome

Use this workflow to demonstrate the optimistic locking capabilities provided by the Cisco BAC API.



Note

Locking of objects is done in multiuser systems to preserve integrity of changes, so that one person's changes do not accidentally get overwritten by another. With optimistic locking, you write your program assuming that any commit has a chance to fail if at least one of the objects being committed was changed by someone else since you began the transaction.

- Step 1** The service representative selects the search option in the service provider's user interface and enters the cable modem's MAC address.
- Step 2** Cisco BAC queries the embedded database, gets the details of the device, and the MSO user interface displays the information.

```
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

final DeviceID modemMACAddress = DeviceID.getInstance("1,6,00:11:22:33:44:55",
    KeyType.MAC_ADDRESS);
List<DeviceDetailsOption> options = new ArrayList<DeviceDetailsOption>();

options.add(DeviceDetailsOption.INCLUDE_LEASE_INFO);

// MSO admin UI calls the provisioning API to query the details
// for the requested device. Query may be performed based on MAC
// address or IP address, depending on what is known about the
// device.

batch.getDetails(modemMACAddress, options);

// post the batch to RDU server
```



```

BatchStatus batchStatus = null;

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}

```

Step 3 The service representative attempts to change the Class of Service and the DHCP Criteria of the modem using the user interface. This in turn invokes the Cisco BAC API.

```

Map<String, Object> deviceDetails = new TreeMap((Map<String,
    Object>)batchStatus.getCommandStatus(0).getData());

// extract device detail data from the map

String deviceType = (String)deviceDetails.get(DeviceDetailsKeys.DEVICE_TYPE);
String macAddress = (String)deviceDetails.get(DeviceDetailsKeys.MAC_ADDRESS);
String relayAgentID = (String)deviceDetails.get(DeviceDetailsKeys.RELAY_AGENT_MAC);
Boolean isProvisioned = (Boolean)deviceDetails.get(DeviceDetailsKeys.IS_PROVISIONED);

// Let's save the OID_REVISION_NUMBER property so that we can set it in
// step 3.

String oidRevisionNumber =
    (String)deviceDetails.get(GenericObjectKeys.OID_REVISION_NUMBER);

// We need a reference to Batch instance so that ensureConsistency()
// method can be invoked on it.

batch = conn.newBatch();
List<String> oidList = new ArrayList<String>();

// Add the oid-rev number saved from step 2 to the list

oidList.add(oidRevisionNumber);

// Sends a list of OID revision numbers to validate before processing the
// batch. This ensures that the objects specified have not been modified
// since they were last retrieved.

batch.ensureConsistency(oidList);
batch.changeClassOfService (
    new MACAddress("1,6,00:11:22:33:44:55"), // macORFqdn: unique identifier for the
                                                // device.
    "gold" // newCOSName : Class of service name.
);

batch.changeDHCPCriteria (
    new MACAddress("1,6,00:11:22:33:44:55"), // macORFqdn: unique identifier for the
                                                // device.
    "specialDHCPCriteria" // newDHCPCriteria : New DHCP Criteria.
);

// This batch fails with BatchStatusCodes.BATCH_NOT_CONSISTENT,
// in case if the device is updated by another client in the meantime.
// If a conflict occurs, then the service provider client
// is responsible for resolving the conflict by querying the database
// again and then applying changes appropriately.
}

```

}

Step 4 The user is ready to receive Gold Class of Service with appropriate DHCP Criteria.

Temporarily Throttling a Subscriber's Bandwidth

An MSO has a service that allows a subscriber to download only 10 MB of data a month. Once the subscriber reaches that limit, their downstream bandwidth is turned down from 10 MB to 56 K. When the month is over they are moved back up to 10 MB.



Note

You may want to consider changing upstream bandwidth as well, because peer-to-peer users and users who run websites tend to have heavy upload bandwidth.

Desired Outcome

Use this workflow to move subscribers up and down in bandwidth according to their terms of agreement.

Step 1 The MSO has a rate tracking system, such as *NetFlow*, which keeps track of each customer's usage by MAC address. Initially a customer is provisioned at the *Gold Class* of Service level with 1 MB downstream.

Step 2 When the rate tracking software determines that a subscriber has reached the 10-MB limit it notifies the OSS. The OSS then makes a call into the Cisco BAC API to change the subscriber's Class of Service from *Gold* to *Gold-throttled*.

```
PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// AUTOMATIC is the activation mode because we are
// attempting to reset the modem so that it
// receives low bandwidth service.
// NO_CONFIRMATION is the confirmation mode
// because we do not want the batch to fail if we cannot
// reset the modem. If the modem is off, then it will
// be disabled when it is turned back on.
// Let's change the COS of the device so that it restricts
// bandwidth usage of the modem.

batch.changeClassOfService(
    new MACAddress("1,6,00:11:22:33:44:55"), // macAddress: unique identifier for
                                           // this modem
```

```

        "Gold-throttled"                // newClassOfService: restricts
                                        // bandwidth usage to 56k
    );

    BatchStatus batchStatus = null;

    // post the batch to RDU server

    try
    {
        batchStatus = batch.post();
    }
    catch(ProvisioningException e)
    {
        e.printStackTrace();
    }
}

```

- Step 3** At the end of the billing period, the OSS calls the Cisco BAC API to change the subscriber's Class of Service back to *Gold*.

Preprovisioning CableHome WAN-MAN

A new customer contacts a service provider to order home networking service. The customer expects a provisioned CableHome device.

Desired Outcome

Use this workflow to preprovision a CableHome device so that the cable modem and WAN-MAN components on it will have the appropriate level of service when brought online.

- Step 1** The service provider chooses a subscriber username and password for the billing system.
- Step 2** The service provider chooses the appropriate Class of Service and the DHCP Criteria for the modem component, then adds it to Cisco BAC.

```

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation
    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// Let's provision the modem and the WAN-Man component in the same
// batch.
// To add a DOCSIS modem:

List<DeviceID> docisDeviceIDList = new ArrayList<DeviceID>();
docisDeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:06"));

```

```

batch.add(
    DeviceType.DOCSIS,           // deviceType: DOCSIS
    docisDeviceIDList,         // macAddress: scanned from the label
    null,                       // hostName: not used in this example
    null,                       // domainName: not used in this example
    "0123-45-6789",           // ownerID: here, account number from billing system
    "Silver",                  // classOfService
    "provisionedCM",          // DHCP Criteria: Network Registrar uses this to
                              // select a modem lease granting provisioned IP address
    null                       // properties: not used
);

```

- Step 3** The service provider chooses the appropriate Class of Service and DHCP Criteria for the WAN-MAN component, then adds it to Cisco BAC.

```

List<DeviceID> wanManDeviceIDList = new ArrayList<DeviceID>();
wanManDeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:07"));
batch.add(
    DeviceType.CABLEHOME_WAN_MAN, // deviceType: CABLEHOME_WAN_MAN
    wanManDeviceIDList,           // macAddress: scanned from the label
    null,                         // hostName: not used in this example
    null,                         // domainName: not used in this example
    "0123-45-6789",             // ownerID: here, account number from billing
                                // system
    "silverWanMan",              // classOfService
    "provisionedWanMan",         // DHCP Criteria: Network Registrar uses this to
                                // select a modem lease granting provisioned IP
                                // address
    null                         // properties: not used
);
}

```

- Step 4** The CableHome device is shipped to the customer.
- Step 5** The customer brings the CableHome device online.

CableHome with Firewall Configuration

A customer contacts a service provider to order a home networking service with the firewall feature enabled. The customer expects to receive a provisioned CableHome device.

Desired Outcome

Use this workflow to preprovision a CableHome device so that the cable modem and the WAN-MAN components on it have the appropriate level of service when brought online.

- Step 1** The service provider chooses a subscriber username and password for the billing system.
- Step 2** The service provider chooses the appropriate Class of Service and DHCP Criteria for the cable modem component, then adds it to Cisco BAC.

```

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

```

```

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

// Let's provision the modem and the WAN-Man component in the same
// batch.
// To add a DOCSIS modem:

List<DeviceID> docisDeviceIDList = new ArrayList<DeviceID>();
docisDeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:06"));
batch.add(
    DeviceType.DOCSIS,        // deviceType: DOCSIS
    docisDeviceIDList,       // macAddress: scanned from the label
    null,                    // hostName: not used in this example
    null,                    // domainName: not used in this example
    "0123-45-6789",         // ownerID: here, account number from billing system
    "Silver",               // classOfService
    "provisionedCM",        // DHCP Criteria: Network Registrar uses this to
                            // select a modem lease granting provisioned IP address
    null                     // properties: not used
);

```

Step 3 The service provider chooses the appropriate Class of Service and DHCP Criteria for the WAN-MAN component and adds it to Cisco BAC.

```

//      Continuation of the batch in Step 2
// To add the WAN-Man component:
// Create a Map to contain WanMan's properties

Map<String, Object> properties = new HashMap<String, Object>();

// The fire wall configuration for the Wan Man component is specified
// using the CableHomeKeys.CABLEHOME_WAN_MAN_FIREWALL_FILE property.
// This use case assumes that the firewall configuration file named
// "firewall_file.cfg" is already present in the RDU database and the
// firewall configuration is enabled in the Wan Man configuration file
// specified with the corresponding class of service.

properties.put(CableHomeKeys.CABLEHOME_WAN_MAN_FIREWALL_FILE, "firewall_file.cfg");

List<DeviceID> wanManDeviceIDList = new ArrayList<DeviceID>();
wanManDeviceIDList.add(new MACAddress("1,6,01:02:03:04:05:07"));
batch.add(
    DeviceType.CABLEHOME_WAN_MAN, // deviceType: CABLEHOME_WAN_MAN
    wanManDeviceIDList,          // macAddress: scanned from the label
    null,                        // hostName: not used in this example
    null,                        // domainName: not used in this example
    "0123-45-6789",             // ownerID: here, account number from billing system
    "silverWanMan",            // classOfService
    "provisionedWanMan",       // DHCP Criteria: Network Registrar uses this to
                            // select a modem lease granting provisioned IP
                            // address
    null                         // properties: not used
);

BatchStatus batchStatus = null;

// post the batch to RDU server

```

```

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

- Step 4** The CableHome device is shipped to the customer.
- Step 5** The customer brings the CableHome device online and the cable modem and the WAN-MAN component get provisioned IP addresses and proper configuration files.
-

Retrieving Device Capabilities for CableHome WAN-MAN

A service provider wants to allow an administrator to view capabilities information for a CableHome WAN-MAN device.

Desired Outcome

The service provider's administrative application displays all known details about a given CableHome WAN-MAN component, including MAC address, lease information, provisioned status, and the device capabilities information.

- Step 1** The administrator enters the MAC address of the WAN-MAN being queried into the service provider's user interface.
- Step 2** Cisco BAC queries the embedded database for details of the device identified using the MAC address entered.

```

PACEConnection conn = PACEConnectionFactory.getInstance(
    "localhost", 49187, "admin", "admin123");

Batch batch = conn.newBatch(

    // No reset

    ActivationMode.NO_ACTIVATION,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION,

    // No publishing to external database

    PublishingMode.NO_PUBLISHING);

final DeviceID modemMACAddress = DeviceID.getInstance("1,6,00:11:22:33:44:55",
    KeyType.MAC_ADDRESS);

List<DeviceDetailsOption> options = new ArrayList<DeviceDetailsOption>();
options.add(DeviceDetailsOption.INCLUDE_LEASE_INFO);

```

```

// MSO admin UI calls the provisioning API to query the details
// for the requested device. Query may be performed based on MAC
// address or IP address, depending on what is known about the
// device.

batch.getDetails(modemMACAddress, options);

// post the batch to RDU server

BatchStatus batchStatus = null;
try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}

```

- Step 3** The service provider’s application then presents a page of device data details, which can display everything that is known about the requested device. If the device was connected to the service provider’s network, this data includes lease information, such as the IP address or the relay agent identifier. This data indicates whether the device is provisioned. If it is provisioned, the data also includes the device type and device capabilities information.

```

Map<String, Object> deviceDetails = new TreeMap<(Map<String,
    Object>)batchStatus.getCommandStatus(0).getData());

// extract device detail data from the map

String deviceType = (String)deviceDetails.get(DeviceDetailsKeys.DEVICE_TYPE);
String macAddress = (String)deviceDetails.get(DeviceDetailsKeys.MAC_ADDRESS);
String relayAgentID = (String)deviceDetails.get(DeviceDetailsKeys.RELAY_AGENT_MAC);
Boolean isProvisioned = (Boolean)deviceDetails.get(DeviceDetailsKeys.IS_PROVISIONED);

String deviceID = (String) deviceDetails.get(CNRNames.DEVICE_ID.toString());
String serNum = (String) deviceDetails.get(CNRNames.DEVICE_SERIAL_NUMBER.toString());
String hwVer = (String)
    deviceDetails.get(CNRNames.HARDWARE_VERSION_NUMBER.toString());
String swVer = (String)
    deviceDetails.get(CNRNames.SOFTWARE_VERSION_NUMBER.toString());
String brVer = (String) deviceDetails.get(CNRNames.BOOT_ROM_VERSION.toString());
String vendorOui = (String) deviceDetails.get(CNRNames.VENDOR_OUI.toString());
String modelNum = (String) deviceDetails.get(CNRNames.MODEL_NUMBER.toString());
String vendorNum = (String) deviceDetails.get(CNRNames.VENDOR_NAME.toString());

// The admin UI now formats and prints the detail data to a view page
}
}

```

Self-Provisioning CableHome WAN-MAN

A subscriber has a computer with a browser application installed in a single-dwelling unit and has purchased an embedded CableHome device.

Desired Outcome

Use this workflow to bring a new unprovisioned embedded CableHome device online with the appropriate level of service, and give the subscriber Internet access from computers connected to the embedded CableHome device.

-
- Step 1** The subscriber purchases an embedded CableHome device and installs it at home.
- Step 2** The subscriber powers on the embedded CableHome device. Cisco BAC gives the embedded cable modem restricted access, allowing two sets of CPE: one for the CableHome WAN-MAN and the other for the computer.



Note This use case assumes an unprovisioned DOCSIS modem allows two sets of CPE behind it. Until configured to do otherwise, Cisco BAC supports only a single device behind an unprovisioned DOCSIS modem. You can change this behavior by defining an appropriate Class of Service that supports two sets of CPE and then using it as the default Class of Service for DOCSIS devices.

- Step 3** Cisco BAC configures the CableHome WAN-MAN, including IP connectivity and downloading the default CableHome boot file. The default CableHome boot file configures the CableHome device in passthrough mode. The CableHome device is still unprovisioned.
- Step 4** The subscriber connects the computer to the CableHome device. The computer gets an unprovisioned (restricted) IP address. The subscriber starts a browser application on the computer. A spoofing DNS server points the browser to the service provider's registration server (for example, an OSS user interface or a mediator).
- Step 5** The subscriber uses the service provider's user interface to complete the steps required for cable modem registration, including selecting a Class of Service. The subscriber also selects a CableHome Class of Service.
- Step 6** The service provider's user interface passes the subscriber's information to Cisco BAC, including the selected Class of Service for cable modem and CableHome, and computer IP address. The subscriber is then registered with Cisco BAC.
- Step 7** The user interface prompts the subscriber to reboot the computer.
- Step 8** The provisioning client calls *performOperation(...)* to reboot the modem and gives the modem provisioned access.

```
// create a new batch

batch = conn.newBatch(

    // No reset

    ActivationMode.AUTOMATIC,

    // No need to confirm activation

    ConfirmationMode.NO_CONFIRMATION);

// register performOperation command to the batch
```



```
batch.performOperation(DeviceOperation.RESET, modemMACAddressObject, null);

// post the batch to RDU server

try
{
    batchStatus = batch.post();
}
catch(ProvisioningException e)
{
    e.printStackTrace();
}
}
```

- Step 9** When the computer is rebooted, it receives a new IP address from the CableHome device's DHCP server. The cable modem and the CableHome device are now both provisioned. Now the subscriber can connect a number of computers to the Ethernet ports of the CableHome device and they have access to the Internet.

**Note**

If the configuration file supplied to the WAN-MAN component enables the WAN-Data component on the box, it will be provisioned in the promiscuous mode. This assumes that the promiscuous mode is enabled at the technology defaults level for the DeviceType.CABLEHOME_WAN_DATA device type.
