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| **Cable**LabsSpecification Engineering Change (EC) Form |
| **EC Tracking Information (Blue fields to be completed by CableLabs only)** |
| **Project** | DOCSIS | **Status** | N | **Identifier** | eRouter-N-19.2005-2 | **Version** | 2 |
| **Affected Specification** | CM-SP-eRouter-I19-160923 |
| **ECR Date** | 2/14/2019 | **Comment Period End Date** | 4/17/2019 | **Severity** | **Change Type** |
| **ECO Date** | 4/25/2019 | **Comment Period End Date** | 5/1/2019 | **[x]  Non-Critical** | **[x]  Minor** |
| **ECN Date** | 5/2/2019 | **Cert Wave No** |  | [ ]  **Critical** | **[ ]  Major** |
| **ECN Effective Date** |  | **Overall Type of Change (Tech/Edit/Both)** | Technical |

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to submit ec, email completed form to: docsis\_ec@cablelabs.com

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| **specification document details** |
| **Document EC is written against:**   **Issued Version #** I19 |
| **author information** |
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| **Additional Contributors** |       |
| **engineering change document details** |
| **Title of EC** | Changes to DHCP behaviour for eRouter |
| **Date sent to CableLabs** | 1/14/19 |  |
| **ec revision history** |
| **Date of revised EC** |       |
| **Brief description of revision** |       |
| **detailed proposed changes** |
| Sections Affected | Section 7 |
| REQs Affected |  | Test Plans Affected |  |

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| **Does this EC request a new TLV or sub-TLV number?** Yes \_\_\_ No \_\_\_ **See embedded change detail for TLV table templates** |
| **Does this EC request a new figure or graphic?**  Yes \_\_\_**If yes, attach all graphic files and list those attached files in the table below. NOTE: Graphics submitted are to be editable except for UML diagrams.** |

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| other related engineering changes (list all the apply) |
| The following EC(s) are recommended to be processed in conjunction with this document:  |
| **EC#** | **Title of EC** | **Affected Document** |
|  | Changes to DHCP behaviour for CM | CM-SP-MULPIv3.1 |

**NOTE! IMPORTANT EC AUTHOR INSTRUCTIONS:**

**For an ECR to advance to ECO status:**

- Requirements Affected section of the embedded DOCSIS-SpecDetailChange.docx must be completed.

- If applicable, the embedded TestPlanDetailChanges.docx must be completed.

**For an ECO to advance to ECN status:**

- If applicable, compiled MIB files and final Schema docs must be attached before requested changes can move to ECN status and noted as attachments in the table directly below.

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| **This Engineering Change has the following file(s) attached.**  |
| **Type of Attachment(s)** (Visio, Word, txt, .yang, etc.) | **File Name of Attachment(s)** |
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**DETAILED DESCRIPTION OF PROBLEM:**

In my capacity as a Systems Architect for Comhem, an MSO in Sweden with roughly 750 000 modems, I have become aware of specific problems that I believe might be facing other MSOs with respect to DHCP retry behaviors defined in the eRouter specification.

When we started our inquiry with CableLabs, it was pointed out that DHCP retry behavior in the eRouter specification was taken directly from the MULPI specification. We then started to look at the CMs we have in the field, and how they behave when their IP lease time expires. What we found in surveying our CMs in the field is that they reset if their IP lease expires, without exception. The specific details of this behavior does not appear to be described in either eRouter or MULPI.

Comhem uses lease times of 48 hours for CMs and E-MTAs and use a 2-hour lease times for CPEs and eRouters. All addresses assigned are from the public IP address space.

I understand and share the concerns of the other MSOs that if we have a massive power outage that the DHCP server needs to be protected from floods of requests, but we feel that these considerations are already addressed in the IP acquisition process, where an eRouter has to acquire an IP in order to reach an operational state, initializing its LAN interfaces and IP applications.

If 5 DISCOVERS retries fail, a modem will be forced to reset. However in the case where an embedded CM is already REGISTERED and it is the eRouter’s lease that expires, there is nothing in the specification that allows the eRouter to recover under such circumstances.

We have experienced recurring issues during the upgrade of our distribution and access network equipment that has resulted in extended service outages due to unexpected behavior on the part of the CM and eRouter. During a recent upgrade of the firewalls that protect the provisioning complex, we discovered that it took extraordinary measures and several hours to recover the CMs and eRouters on our access network due to the DHCP retry behavior of the CMs and eRouters.

Specifically, the fault resulted in roughly 200,000 eRouters out of 650,000 failing to recover after the DHCP servers were once again available. We identified the cause of the fault during root cause analysis and discovered that the eRouter’s IP lease would reach expiration while the device’s embedded CM’s lease remained valid, resulting in the eRouter no longer forwarding traffic on the LAN once it had made 5 retry attempts and given up attempting further retries. Per the specification, the eRouter will only attempt to retry 5 times, but will then cease to retry until the device is reset. The eRouter specification demands that the eRouter stop forwarding traffic when its IP address expires, disrupting the LAN-side of the router.

From an operational perspective, we observed no alarms when the eRouters on our network stopped attempting to reach the DHCP servers. All of the embedded CMs remained online and registered, but the customers didn’t have any service, resulting in many complaints being received by the call center.

We analyzed the eRouter specification and confirmed that the retry behavior defined there prevents further DHCP retry attempts after 5 retries have been attempted. Some of the eRouters we deployed followed this behavior, while others appeared to deviate from the specification and continued to retry, sending DHCP DISCOVER messages every 2 minutes. The devices violating the currently defined DHCP retry behavior became operational immediately after we finished upgrading the firewalls that protect our provisioning system and access to the DHCP servers was restored. This was not the case for eRouters that followed the specification. The proposed change to eRouter is what we feel best reflects both the real-life scenarios and the behavior we observed that many of our eRouters already had that has proven to work well. We feel the current behavior creates problems that cannot be easily resolved by other means than by rectifying the issue in the specification.

Several years ago, the customer’s PC was connected directly to the CM, but with the introduction of the eRouter, the PC was connected directly to the eRouter. In those days a simple reset would have done fine. As the years have passed, more and more network and home automation appliances have been introduced into the customer’s home and most of those continue to work even after the link to the Internet is lost.

I have proposed a change to an existing requirement that I feel best supports maintaining continuity on the customer’s LAN during an Internet outage. “REQ17261 The eRouter MUST NOT forward IPv4 traffic between its Customer-Facing Interface and its Operator-Facing Interface if, at any time, it does not have an IPv4 address for its Operator-Facing Interface. “ The previous wording stated that the eRouter is not allowed to forward any traffic at all, not even on the LAN-side, if the eRouter’s IP lease expires. My suggested change only prevents the eRouter from attempting to forward traffic from LAN to WAN if the eRouter lease expires, while local LAN traffic is still permitted, if the vendor or MSO so chooses. We feel that the currently defined behaviors create problems in production that cannot be easily resolved by other means than rectifying the issue in the specification.

The proposed change is only applicable for the WAN interface of the eRouter, not the CM interface of the embedded CM inside the eRouter. The CM interface still falls under MULPI Specification.

**CHANGE DETAILS FOR THE SPECIFICATION:**

Complete Engineering Change details **for the specification are** contained in the following embedded file:



**CHANGE DETAILS FOR THE TEST PLAN (ATP):**

Complete Engineering Change details **for the test plan is** contained in the following embedded file:

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**End of Request**

**Additional Instructions to EC Author**

