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# IPCablecom2 residential SIP telephony: embedded digital voice adapter (E-DVA) specification

Recommendation ITU-T J.460.2

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## IPCablecom2 residential SIP telephony: embedded digital voice adapter (E-DVA) specification


### Summary

Recommendation ITU-T J.460.2 defines the embedded Digital Voice Adaptor (E-DVA) requirements for the analog interface and for powering of the E-DVA. An embedded DVA is a DOCSIS cable modem (CM) integrated with an IPCablecom2 DVA. These requirements enable a sufficiently reliable service to meet assumed consumer expectations related to residential telephony.



### Source

Recommendation ITU-T J.460.2 was approved on 13 June 2008 by ITU-T Study Group 9 (2005-2008) under Recommendation ITU-T A.8 procedure.

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# Recommendation ITU-T J.460.2

## IPCablecom2 residential SIP telephony: embedded digital voice adapter (E-DVA) specification

## 1 Scope

This Recommendation defines the embedded Digital Voice Adaptor (E-DVA) requirements for the analog interface and for powering of the E-DVA. An embedded DVA is a DOCSIS cable modem (CM) integrated with an IPCablecom2 DVA.

The purpose of this Recommendation is to define a set of requirements that will enable a sufficiently reliable service to meet assumed consumer expectations related to residential telephony. These assumed expectations include constant availability, including availability during power failure at the customer's premises, and access to emergency services (e.g., 121 or 911).

It is an important objective of this work that interoperability between IPCablecom 2.0 and 3GPP IMS is provided. IPCablecom 2.0 is based upon 3GPP IMS, but includes additional functionality necessary to meet the requirements of cable operators. Recognizing developing converged solutions for wireless, wireline, and cable, it is expected that further development of IPCablecom 2.0 will continue to monitor and contribute to IMS developments in 3GPP, with the aim of alignment of 3GPP IMS and IPCablecom 2.0.

NOTE – The structure and content of this Recommendation have been organized for ease of use by those familiar with the original source material; as such, the usual style of ITU-T recommendations has not been applied.

## 2 References

### 2.1 Normative References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.


[CODEC-MEDIA] Recommendation ITU-T J.361 (2006), *IPCablecom2 Codec Media*.

[DOCSIS OSSIv2.0] ANSI/SCTE 79-2 2002, *DOCS 2.0 Operations Support System Interface*.

[DOCSIS RFIv2.0] Recommendation ITU-T J.122 (2002), *Second-generation transmission systems for interactive cable television services – IP cable modems*.

[eDOCSIS] Recommendation ITU-T J.126 (2007), *Embedded Cable Modem device specification*.

[G.168] Recommendation ITU-T G.168 (2004), *Digital network echo cancellers*.

[G.711] Recommendation ITU-T G.711 (1988), *Pulse code modulation (PCM) of voice frequencies*.

[PKT 23.228] Recommendation ITU-T J.366.3 (Draft), *IPCablecom2 IP Multimedia Subsystem Stage 2 (3GGP TS 23.228)*.

[PKT 24.229] Recommendation ITU-T J.366.4 (Draft), *IPCablecom2 SIP and SDP Stage 3 (3GPP TS 24.229)*.

| | |
|---|---|
| [PKT 33.203] | Recommendation ITU-T J.366.7 (Draft), *IPCablecom2 Access Security for IP-Based Services (3GPP TS 33.203).* |
| [RFC 4330] | IETF RFC 4330, *Simple Network Time Protocol version 4 for IPv6, IPv4, and OSI*, January, 2006. |
| [RSTF] | Recommendation ITU-T J.460.1, *IPCablecom2 Residential SIP Telephony Feature Specification.* |
| [SEC1.5] | Recommendation ITU-T J.170, *IPCablecom security specification.* |
| [RST E-UE Prov] | Recommendation ITU-T J.460.4 (draft) – *IPCablecom2 RST E-UE Provisioning Specification.* |

## 2.2 Informative References

This Recommendation uses the following informative references.

| | |
|---|---|
| [ARCH-FRM TR] | Recommendation ITU-T J.360, *IPCablecom2 Architecture Framework.* |
| [ID MMUSIC LOOPBACK] | IETF Internet Draft, *An Extension to the Session Description Protocol (SDP) for Media Loopback,* draft-ietf-mmusic-media-loopback-04.txt, August 2006, *work in progress.* |
| [ID SIP ANSWERMODE] | IETF Internet Draft, *Requesting Answering Modes for the Session Initiation Protocol (SIP),* draft-ietf-sip-answermode-01, April 2006, *work in progress.* |
| [Key Smith] | P. Key and D. Smith (editors). 1999. *The Internet & The Public Switched Telephone Network – A Troubled Marriage. In Teletraffic Engineering in a Competitive World. Edinberg: Elsevier.* |
| [NFT TR] | Recommendation ITU-T J.360, *IPCablecom2 Architecture Framework Appendix V NAT and Firewall Traversal.* |
| [V.25] | Recommendation ITU-T V.25 (1996), *Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls.* |

## 2.3 Reference Acquisition

- IHS Standards Store, Internet: http://global.ihs.com/
- Internet Engineering Task Force (IETF), Internet: http://www.ietf.org/

NOTE – Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time.

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt.

# 3 Terms and Definitions

This Recommendation defines the following terms:

**3.1 customer premises equipment**: Usage of CPE within this Recommendation generically refers to the cable modem and E-DVA device that resides at the subscriber home, as well as any customer telephony equipment (telephones, answering machines, fax machines, etc.). Typically, CPE would refer to equipment that is beyond the service provider network interface, such as a telephone or personal computer. However, since the cable modem and E-DVA represent the service provider network interface device at the subscriber home, it is commonly referred to as CPE.

**3.2 hybrid fibre coax**: Access network architecture consisting of fibre-optic feeders from the head end to nodes, at which point a coaxial cable is used for the final distribution to the subscribers.

**3.3 uninterruptible power supply**: A power supply including a battery for backup power when AC input power fails.

## 4 Abbreviations, acronyms and conventions

### 4.1 Abbreviations and Acronyms

This Recommendation uses the following abbreviations:

| | |
|---|---|
| A/D | Analog to Digital converter |
| CCS | One Hundred Call Seconds |
| CM | Cable Modem |
| CMS | Call Management Server |
| CMTS | Cable Modem Termination System |
| CPE | Customer Premises Equipment |
| CSCF | Call Session Control Function |
| D/A | Digital to Analog converter |
| DOCSIS® | Data-Over-Cable System Interface Specifications |
| DTMF | Dual Tone Multi Frequency |
| DVA | Digital Voice Adaptor |
| eCM | Embedded Cable Modem |
| eDOCSIS™ | Embedded Data-Over-Cable System Interface Specification |
| E-DVA | Embedded Digital Voice Adaptor |
| FITL | Fibre In The Loop. A PSTN architecture consisting of a fibre-optic access network |
| HFC | Hybrid Fibre Coax |
| IP | Internet Protocol. A network layer protocol |
| LEC | Local Exchange Carrier |
| NAT | Network Address Translation |
| NCS | Network Call Signalling |
| OSSI | Operations Support System Interface |
| POTS | Plain Old Telephone Service |
| PSTN | Public Switched Telephone Network |
| RST | Residential SIP Telephony |
| RTCP | Real Time Control Protocol |
| RTCP XR | Real Time Control Protocol Extended Reports |
| SDP | Session Description Protocol |

| | |
|---|---|
| SIP | Session Initiation Protocol |
| STUN | Simple Traversal of User Datagram Protocol (UDP) Through Network Address Translators |
| UDP | User Datagram Protocol |
| UPS | Uninterruptible Power Supply |

## 4.2 Conventions

Throughout this Recommendation, the words that are used to define the significance of particular requirements are capitalized. These words are:

| | |
|---|---|
| "MUST" | This word means that the item is an absolute requirement of this Recommendation. |
| "MUST NOT" | This phrase means that the item is an absolute prohibition of this Recommendation. |
| "SHOULD" | This word means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course. |
| "SHOULD NOT" | This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label. |
| "MAY" | This word means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item. |

# 5 Overview

## 5.1 IPCablecom2 Overview

The IPCablecom2 project is aimed at defining interface Recommendations that can be used to develop interoperable equipment capable of providing packet-based voice, video, and other high-speed multimedia services over hybrid fibre coax (HFC) cable systems utilizing the Data-Over-Cable Interface Specification [DOCSIS RFIv2.0].

## 5.2 Service Goals

One application of the IPCablecom2 architecture is packet-based voice communications for cable system subscribers. The IPCablecom2 architecture as a whole enables voice communications, video, and data services based on bidirectional transfer of Internet Protocol (IP) traffic between the cable system headend and customer locations, over an all-coaxial or HFC cable network as shown in simplified form in Figure 1.

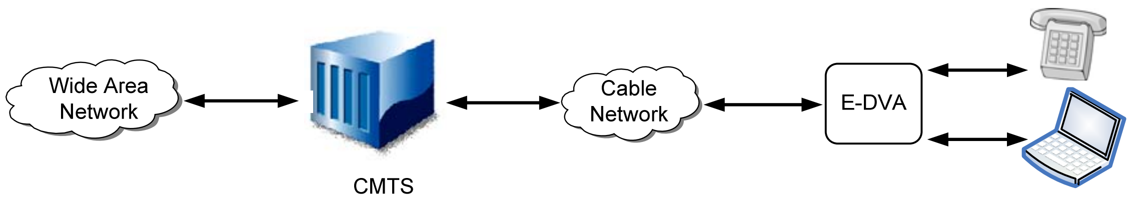


**Figure 1 – Telephony Services Over the Data-Over-Cable System**

The transmission path over the cable system is realized by a cable modem termination system (CMTS) and at each customer location by a cable modem (CM). The E-DVA includes an embedded cable modem and a Residential SIP Telephony (RST) client and analog ports for telephone devices. The E-DVA may include digital ports. The conversion between digital RST signaling and voice to analog telephone interfaces is accomplished within the E-DVA.

## 5.3 IPCablecom2 Reference Architecture

For a description of the IPCablecom2 architecture and Functional Components, please refer to [ARCH-FRM TR].

## 5.4 Embedded Digital Voice Adaptor

A Digital Voice Adaptor (DVA) is an IPCablecom2 client device that contains a subscriber-side interface to the subscriber's CPE (e.g., telephone) and a network-side signaling interface to call control elements in the network (e.g., P-CSCF, S-CSCF, Application servers, etc.). A DVA provides codecs and all signaling and encapsulation functions required for media transport and call signaling.

DVAs reside at the customer side and are connected to other IPCablecom2 network elements via the HFC access network (DOCSIS). IPCablecom2 DVAs are required to support the SIP protocol as specified in IPCablecom2 Recommendation [RSTF].

IPCablecom2 only defines support for an embedded DVA (E-DVA). An E-DVA is a single hardware device that incorporates a DOCSIS 1.1 or higher CM as well as an IPCablecom2 DVA component. Figure 2 shows a representative functional diagram of an E-DVA. Additional E-DVA functionality is further defined in [ARCH-FRM TR]. For the purposes of this Recommendation, DVA is interpreted to be identical to E-DVA.

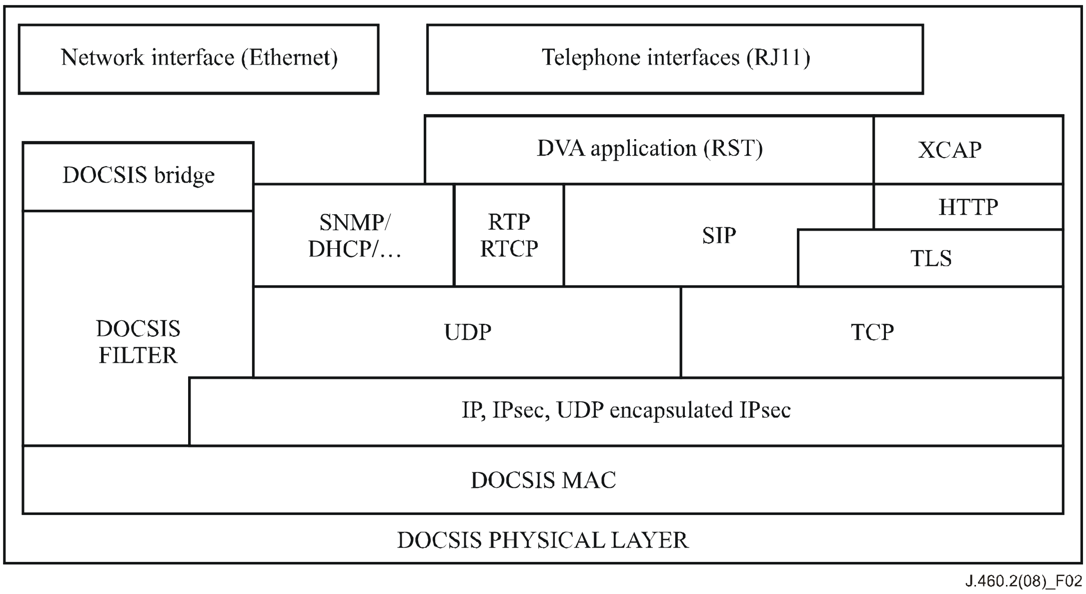


**Figure 2 – E-DVA Protocols**

# 6 E-DVA power requirements

This clause defines the power requirements of the E-DVA. This includes power consumption and presents associated traffic models recommended for power consumption calculations.

## 6.1 Power Considerations

Local power refers to utilizing the subscriber's home AC utility power as the supply for the E-DVA. A battery backup is utilized to provide telephony services when the utility power fails.

## 6.2 Typical E-DVA Traffic Model

In order to properly dimension the power equipment, it is necessary to calculate long-term average power usage. Since these are likely to vary considerably from location to location, it is impossible to have a single answer. One method to estimate the average long-term power requirements is described in Appendix I.

## 6.3 Service Requirements Under AC Fail Conditions

The E-DVA MUST remain operational during the switch between AC outage to battery backup. The E-DVA MUST also maintain provisioned services (operational means capable of originating calls, ringing, and terminating calls, if provisioned as in-service). When in battery mode, services will be offered as configured by the operator. This configuration may be different from the services when provided with AC power. The E-DVA MUST maintain established telephony calls across the switchover between AC power and battery backup. Since data traffic is not required for an IPCablecom2 service, the E-DVA data service MAY be de-activated immediately under local AC power fail conditions.

## 6.4 Local Powering with Battery Backup

Local powering is accomplished utilizing a UPS that converts household AC power to DC power for the E-DVA. The UPS also provides battery backup to bridge E-DVA operation through typical local power outages. In addition, telemetry signals provide remote monitoring capability for local AC power and battery conditions. The indoor climate controlled environment is typically desired for battery placement to maximize battery life. E-DVAs MAY include an embedded UPS or utilize an external UPS.

# 7 E-DVA analog port requirements

The E-DVA analog port represents an interface between the IPCablecom2/DOCSIS/IP (Internet protocol) network and devices designed to function when connected to the PSTN using standard PSTN interfaces. The subscriber side of this interface is an analog interface consistent with the PSTN, and the network side of this interface is a digital interface to the IP-based IPCablecom2 network, which rides on top of the DOCSIS transport. It is expected that many operators will choose to use the IPCablecom2 architecture to offer services to customers in residential dwellings. In such applications, the E-DVA will reside at the subscriber premises, typically as an interior unit with battery backup. Finally, because the network side of the port interface is digital, and the device resides close to the subscriber, the analog subscriber side of the port interface will only be required to support relatively short metallic (copper twisted pair) drops (i.e., 150 metres).

Since there are many different analog port specifications in use throughout the world, this Recommendation will not specify one. The E-DVA MUST have an analog port that conforms to appropriate National practices. An example of such a port is given in Appendix I.

# 8 Client requirement

## 8.1 Provisioning

The E-DVA MUST comply with the E-DVA provisioning requirements as specified in [RST E-UE-Prov].

## 8.2 Security

The security considerations for the E-DVA are based on those specified in [PKT 33.203], [PKT 23.228], [PKT 24.229], and [NFT TR]. The requirements specific to the E-DVA are provided below.

### 8.2.1 Authentication

As part of the SIP registration for each provisioned line, the E-DVA MUST support SIP-Digest-based authentication with the IPCablecom2 core network as detailed in [PKT 33.203] and [PKT 24.229], using the corresponding Private User Identity/Public User Identity pair and the User ID/Password pair obtained from the Authentication server during the bootstrapping process. The registration also allows the E-DVA to establish any necessary security associations for the SIP signaling security with the P-CSCF, as specified in [PKT 33.203].

The E-DVA MAY support any other authentication procedure described in [PKT 33.203].

### 8.2.2 Signaling Security

The E-DVA MUST support TLS for the SIP-signaling security.

The E-DVA MAY support other signaling-security protocols specified in [PKT 33.203].

For both authentication and signaling security the E-DVA MUST use the X.509v3 certificate profile as follows.

E-DVA certificates MUST follow the MTA Device certificate profile specified in [SEC1.5]. Existing IPCablecom certificates are being reused for IPCablecom2 Release 2.0. E-DVA certificates MUST be issued by MTA Manufacturer Certificate Authorities as specified in [SEC1.5].

In order to perform authentication for secure configuration, the E-DVA MUST possess the CableLabs Service Provider Root CA certificate. This certificate is installed into each E-DVA at the time of manufacture or with a secure software download as specified in [SEC1.5] and MUST NOT be updated by the provisioning server.

## 8.3 NAT/Firewall Traversal

Even though there is no NAT/Firewall between the E-DVA and the CMTS, there may be a network-based NAT/Firewall behind the CMTS.

The NAT/Firewall traversal requirements described in [PKT 23.228], [PKT 24.229], and [NFT TR] SHOULD be supported by the E-DVA.

## 8.4 Codecs

G.711 μ-law, G.711 A-law [G.711], T.38, V.152, and DTMF Relay MUST be supported by the E-DVA per the [CODEC-MEDIA] Recommendation. Both μ-law and A-law MUST be offered at session establishment if G.711 is offered. The packet period of a G.711 payload is configured as shown in Table 1. The offering of T.38, V.152, and DTMF Relay at session establishment is determined based on the setting of their respective data element as described below. Table 1 provides a summary of the E-DVA data elements related to CODEC configuration.

**Table 1 – E-DVA CODEC Provisioning**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Increments | Default |
|---|---|---|---|---|---|---|---|---|---|
| G.711 Packet | Integer (ms) | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | 10-30 | 10 | 20 |
| T.38 | Boolean | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | N/A | N/A | ON |
| V.152 | Boolean | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | N/A | N/A | ON |
| DTMF Relay | Boolean | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | N/A | N/A | ON |
| RTCP XR Publish_ report | IP address | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | N/A | N/A | n/a |
| RTCP XR | Boolean | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. ERVER | CONFIG. SERVER UE | N/A | N/A | ON |
| RTCP_ RATE | Integer (s) | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER UE | 0-60 | 1 | 5 |

A value of ON for T.38 enables fax relay on the E-DVA. The E-DVA MUST enable T.38 operation as provisioned via the T.38 data element.

A value of ON for V.152 enables modem relay on the E-DVA. The E-DVA MUST enable V.152 operation as provisioned via the V.152 data element.

A value of ON for DTMF Relay enables DTMF Relay on the E-DVA. The E-DVA MUST enable DTMF Relay operation as provisioned via the DTMF Relay data element.

Publish_report defines the network address that receives the call statistics report from the E-DVA. The E-DVA MUST send Publish reports at the end of each call.

RTCP XR determines if extended reports for the sake of voice metrics are included within RTCP packets. A value of ON enables RTCP extended reports. Voice metrics can include network and audio metrics as defined in [CODEC-MEDIA].

RTCP_RATE sets the interval at which RTCP packets are sent from the E-DVA. A value of zero for RTCP_RATE disables RTCP transmission. The E-DVA MUST send RTCP packets at the rate indicated in the RTCP_RATE data element.

If a voice call is switched to T.38 or V.152, the E-DVA MUST use the same packet period as the prior voice stream for transmitting data.

## 8.5 Loopback Test Capability

The IPCablecom2 network may initiate a test call to the E-DVA to request that the E-DVA then be set into loopback mode in order for the network to send RTP streams to the E-DVA, and receive the same stream back. This allows the network operator to test the voice path and, potentially, a number of voice/packet performance statistics.

### 8.5.1 Test Call Request Encoding

The IPCablecom2 network indicates, via a specific encoding scheme in the SIP INVITE, that the request will initiate a test call and enable RTP loopback.

To indicate an RTP loopback test call, the INVITE received from the network MUST be encoded with:

- A Require header containing the option tag 'answermode' (see [ID SIP ANSWERMODE]).
- An Answermode header containing the parameters 'auto;require'.
- SDP attribute 'loopback' indicating the specific loopback behavior required (see [ID MMUSIC LOOPBACK]).
- SDP attribute 'loopback-source' indicating that the network is the source of the media that will be the subject of the RTP loopback.

### 8.5.2 E-DVA Requirements on Reception of a Loopback Request

On reception of an INVITE request encoded as defined in this clause, the E-DVA MUST:

- Not alert the subscriber.w4
- Provide a 200 OK final response to the INVITE
- Encode the answer SDP provided in the 200 OK according to the rules defined in [ID MMUSIC LOOPBACK]

On reception of RTP packets from the network, once a Loopback mode has been established, the action at the E-DVA is dependent on the contents of the 'loopback' attribute received in the offering SDP from the network.

If the 'loopback' attribute was encoded as 'rtp-pkt-loopback', then E-DVA MUST NOT decode the received RTP packet and instead send the received packet back to the network. The destination IP address and port for the looped RTP is that given in the offering SDP in the initial INVITE.

If the 'loopback' attribute was encoded as 'rtp-media-loopback', then the E-DVA MUST decode and then re-encode the received RTP payload before sending the received packet back to the network if the E-DVA supports media loopback mode. The destination IP address and port for the looped RTP is that given in the offering SDP in the initial INVITE. The E-DVA MUST reject the INVITE with the 'rtp-media-loopback' if the E-DVA does not support the media loopback mode.

The Loopback test session ends upon reception of a BYE from the network on the dialog established by the initial INVITE.

The E-DVA MUST reject an INVITE request encoded as defined in this clause if it has insufficient resources to meet the requirements of the loopback mode. For example, the E-DVA may already be involved in a 3-way call.

The E-DVA SHOULD end the loopback mode with a BYE if the user's request for a 3-way call cannot be serviced due to resource limitations.

## 9 E-DVA Monitoring requirements

The E-DVA is a critical element in the IPCablecom2 architecture. It provides the customer's interface to the service provider's network, and is located outside the service provider's headend. As such, it is critical that the operational status of the E-DVA be monitored in order to provide the quickest information to the service provider. In particular, if the E-DVA fails and is not capable of providing the intended service, the service provider will need be aware in advance of this situation (preferably before the customer).

The minimum goal of fault management should be to isolate failures to a field replaceable unit. Preferably, fault management should be able to identify the failed functional subsystem within the unit. This enables the service provider to dispatch service personnel with the appropriate equipment necessary to troubleshoot and resolve the problem in the least amount of time (i.e., minimize Mean Time To Replacement, or MTTR).

This clause provides the E-DVA monitoring requirements in support of proper fault management. Specifically, it provides the monitoring requirements for three main functional subsystems of the E-DVA: the DOCSIS eCM, the IPCablecom2 E-DVA, and the battery-backup module.

## 9.1 eCM Monitoring

The E-DVA functions as the customer premises network interface to the IPCablecom2 network and thus enables service to the customer. In particular, within the eDOCSIS-compliant E-DVA, the eCM provides the critical connection between the E-DVA and the IPCablecom2 network [eDOCSIS]. An eCM failure will affect the availability of the IPCablecom2 service.

The E-DVA MUST support the eCM failure detection mechanisms defined by DOCSIS Recommendations [DOCSIS RFIv2.0], [DOCSIS OSSIv2.0], and [eDOCSIS].

For the report of the eCM failures, the E-DVA MUST support the event and alarm reporting mechanisms as defined in [RST E-UE Prov].

## 9.2 E-DVA Monitoring

At the minimum, the E-DVA monitoring MUST utilize the eCM failure detection mechanisms defined by DOCSIS Recommendations [DOCSIS RFIv2.0], [DOCSIS OSSIv2.0], and [eDOCSIS].

Additional vendor-specific E-DVA monitoring mechanisms MAY be developed. Such mechanisms can include internal online diagnostics utilized to detect vendor-specific events.

For the report of the E-DVA failures, the E-DVA MUST support the event and alarm reporting mechanisms as defined in [RST E-UE Prov].

## 9.3 Battery-Backup Monitoring

To maintain operation during the utility AC power outage, the E-DVA MAY provide local power with uninterruptible power supply (UPS) battery backup. If the UPS is provided, the E-DVA MUST support the AC Fail, AC Restore, Replace Battery, Battery Good, Battery Missing, Battery Present, Battery Low, and Battery Not Low alarm state telemetry signals for the monitoring of the battery-backup module. For the report of these telemetry signals, the E-DVA MUST support the event and alarm reporting mechanisms as defined in [RST E-UE Prov].

### 9.3.1 Telemetry Signal 1 – AC Fail

The active alarm state of this E-DVA signal MUST indicate an "AC Fail" condition, which means that the UPS has detected a failure of the utility AC power and is operating off its battery.

The inactive alarm state of this E-DVA signal MUST indicate an "AC Restored" condition, which means that the UPS has detected the presence of utility AC power and is no longer operating off its battery.

### 9.3.2 Telemetry Signal 2 – Replace Battery

The active alarm state of this E-DVA signal MUST indicate a "Replace Battery" condition, which means that the UPS, via internal test mechanisms outside the scope of this Recommendation, has determined that the battery can no longer maintain a charge sufficient enough to provide adequate battery backup and thus is failing and should be replaced with a new battery.

The inactive alarm state of this E-DVA signal MUST indicate a "Battery Good" condition.

### 9.3.3 Telemetry Signal 3 – Battery Missing

The active alarm state of this E-DVA signal MUST indicate a "Battery Missing" condition, which means that the UPS has detected that a battery is not present and a battery should be installed in the UPS.

The inactive alarm state of this E-DVA signal MUST indicate a "Battery Present" condition.

### 9.3.4 Telemetry Signal 4 – Battery Low

The active alarm state of this E-DVA signal MUST indicate a "Battery Low" condition, which means that the battery has sufficiently discharged to the point where a power source can only be maintained for a short while longer.

The inactive alarm state of this E-DVA signal MUST indicate a "Battery Not Low" condition, which means that the battery has charged above the "battery low" threshold.

# Appendix I

## Example of a power calculation

(This appendix does not form an integral part of this Recommendation)

A projected "typical" E-DVA traffic model has been developed based on [GR 517] and [Key Smith] and inputs from cable operators. With this qualification, this model may be used to make an initial calculation of long-term average power.

**Table I.1 – E-DVA Traffic Model**

| Line Number | E-DVA Line 1 | E-DVA Line 2 | E-DVA Line 3 | E-DVA Line 4 | Cable Modem Data |
|---|---|---|---|---|---|
| Assumed Use | Voice | Modem/ Voice | Voice/Fax | Voice | High Speed Data |
| Usage (Erlangs) | .11 | .11 | .05 | .05 | .11 |
| Line Penetration (Normalized by Penetration) | 100% | 80% | 50% | 25% | 25% |
| Average Ringing Period | 14 s | 14 s | 14 s | 14 s | n/a |
| Average call length<br>E-DVA w/o Data Service<br>E-DVA with Data Service | <br>5 min<br>5 min | <br>26 min<br>5 min | <br>5 min<br>5 min | <br>5 min<br>5 min | <br>n/a<br>n/a |
| Average Data Rate to Subscriber | n/a | n/a | n/a | n/a | 100 kbit/s |
| Average Data Rate From Subscriber | n/a | n/a | n/a | n/a | 10 kbit/s |

The average cable modem data rates shown in Table I.1 assume that when a user is active on the system (i.e., .11 erlang), the user is interpreting or typing information during 90% of the active session, and no significant data is flowing through the data interface. Data interface rates of 1 Mbit/s to the subscriber and 100 kbit/s from the subscriber are assumed during the remaining 10% of the session. The averages are assumed to be long term and are considered over the entire domain of a power node (i.e., 100's of E-DVAs).

**Example of an analog port requirement**

This Appendix uses the following additional informative references:


[ANSI T1.401] ANSI T1.401, *Network to Customer Installation Interfaces – Analog Voice grade Switched Access Lines Using Loop-Start or Ground Start Signaling with Line-Side answer supervision feature*, 2000.

[GR 30] Telcordia GR-30-CORE, *LSSGR*: *Voiceband Data Transmission Interface*, December 1998, FR-64.

[GR 57] Telcordia, GR-57-CORE, Issue 1, October 2001, *Functional Criteria for Digital Loop Carrier (DLC) Systems*.

[GR 303] Telecordia GR-303, Issue 4, *Integrated Digital Loop Carrier System Generic Requirements, Objectives, and Interface*, December 2002,

[GR 499] Telcordia GR-499-CORE, Issue 4, *Transport Systems Generic Requirements (TSGR): Common Requirements*, September 2004.

[GR 506] Telcordia GR-506-CORE, *LSSGR*: *Signaling for Analog Interfaces*, November, 1996, FR-64.

[GR 517] Telcordia (Bellcore) GR-517-CORE, Issue 1, *LEC Traffic Environment Characteristics*, December 1998.

[GR 909] Telcordia GR-909-CORE, Issue 2, *Generic Requirements and Objectives for Fiber in the Loop (FITL) Systems*, December 2004.

[GR 1089] Telcordia GR-1089-CORE, Issue 4, *Generic Requirements for Electronic Equipment Cabinets, Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment*, June 2006.

[GR 1401] Telcordia GR 1401, *LSSGR*: *Visual Message Waiting Indicator Generic Requirements* (FSD 01-02-2000), June 2000, FR-64.

[SR-TSV-002476] Telcordia Special Report, SR-TSV-002476, *CPE Compatibility Considerations for the Voiceband Data Transmission Interface*, December 1992.

[EN 300 659-1] ETSI EN 300 659-1, *Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 1: On-hook data transmission*, January 2001.

[EN 300 659-3] ETSI EN 300 659-3, *Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 3: Data link message and parameter codings*, January 2001.

[ANSI T1.508] ANSI T1.508, *Network Performance – Loss Plan for Evolving Digital Networks*, 1998.

[TIA-912a] TIA-912a, *Telecommunication – IP Telephony Equipment – Voice Gateway Transmission Requirements*, August 2004.

[TSB-122a] TIA/EIA/TSB 122a, *Telecommunications – IP Telephony Equipment – Voice Router/Gateway loss and Level Plan Guidelines*, March 2001.

This interface is similar to the FITL (fibre in the loop) interface described by Telcordia in [GR 909]. Thus GR-909-CORE has been used as the model for generating these requirements. For basic IPCablecom2 services, the requirements can be divided into four categories:

- Loop Start Signaling
- General Supervision
- General Ringing
- Voice Grade Analog Transmission

The E-DVA analog 2-wire interface requirements are listed in the following clauses.

For the purpose of this clause, the subscriber twisted pair copper wiring (typically the wiring inside the subscriber's premises) that is connected to the E-DVA analog port will be referred to as the "loop". Note that this usage is different from the way these terms may be used in the context of the PSTN, in which the "loop" is defined as the transmission path between a telephone company central office and a customer's premises. The "loop" referred to in this clause, in PSTN terms, would typically be referred to as "premises wire" or "inside wire". References here to "loops" and "transmission paths" should not be confused with links from customer premises to either a telephone company office or to a cable operator's headend.

## I.1 Loop Start Signaling

### I.1.1 DC Supervisory Range

The DC supervisory range MUST meet: RDC ≥ 450 ohms. RDC is the DC supervisory range. The actual value of RDC depends on the resistance of the loop wire from the E-DVA (the subscriber's inside wiring). That is, RDC = 430 ohms + Rloop. Note that this accommodates a drop of 150 metres of service wire at 65 degrees Celsius.

Reference: section 4.1.1 of [GR 909].

### I.1.2 Idle State Voltage

The idle state is when the loop is open or on-hook. In this state, the idle voltage MUST:

- be 42.75 Vdc ≤ VIDLE ≤ 80 V DC; and
- comply with National electrical safety requirements.

In this state, the idle voltage SHOULD:

- have a Ring that is negative with respect to tip
- have Ring-to-ground and tip-to-ground voltages that are < 0

Reference: section 4.1.2 of [GR 909].

### I.1.3 Loop Closure Detection

Loop closure is off-hook. Detection of loop closure in the E-DVA MUST meet:

- Resistance ≤ RDC between tip and ring is loop closure
- Resistance ≥ 10 k ohms between tip and ring is not loop closure

Reference: section 4.1.4 of [GR 909].

### I.1.4 Loop Open Detection

Loop open is on-hook. Detection of loop open in the E-DVA MUST meet:

- Resistance ≥ 10 k ohms is loop open
- Resistance ≤ RDC + 380 ohms is not loop open

The E-DVA MUST be able to distinguish between a hit, dial pulse, flash, or disconnect.

Reference: section 4.1.5 of [GR 909].

### I.1.5 Off-Hook Delay

The E-DVA MUST meet the timing requirements R11-33 of [GR 506] for detecting a subscriber origination request (off-hook).

The E-DVA MUST be able to generate the local dial tone within 50 ms of detecting a subscriber origination request (off-hook).

The E-DVA MUST be capable of establishing a 2-way voice signal transmission capability on the loop established within 50 ms of detecting the subscriber termination request (off-hook).

Reference: section 4.1.7 of [GR 909].

### I.1.6 Flash Hook Delay

The E-DVA MUST meet the timing requirements in section 12 of [GR 506] for detecting a flash signal and a subscriber termination request (on-hook).

The E-DVA MUST be able to signal to the network about a flash signal within 50 ms of detecting such an event.

### I.1.7 On-Hook Delay

The E-DVA MUST meet the timing requirements in section 12 of [GR 506] for detecting an on-hook signal and a subscriber termination request (on-hook).

The E-DVA MUST be able to signal to the network about an on-hook signal or a subscriber termination request within 50 ms of detecting such an event.

### I.1.8 Ringsplash

When a feature requires one 500 ms ringsplash, the E-DVA MUST apply one 500 ± 50 ms ring burst to the line.

Reference: section 4.1.9 of [GR 909].

### I.1.9 Distinctive Alerting

Defined ring cadences MUST be applied to the drop within ±50 ms resolution. The E-DVA MUST be able to apply any of the distinctive alerting patterns described in the IPCablecom2 Residential SIP Telephony Feature Recommendation [RSTF] on the line when signaled by the IPCablecom2 network.

Reference: section 4.1.10 of [GR 909].

### I.1.10 Transmission Path

The E-DVA MUST support part-time on-hook transmission capabilities: part-time = within 400 ms after a ringsplash. On-hook transmission provides the capability of transmitting a voiceband signal in both directions on the loop when the loop is open (on-hook).

Reference: section 4.1.15 of [GR 909].

## I.2 General Supervision

### I.2.1 Off-Hook Loop Current

The E-DVA MUST provide at least 20 mA of loop current in the off-hook state. Loop voltage is such that the ring conductor is negative with respect to the tip conductor.

Reference: section 4.2.1 of [GR 909].

### I.2.2 Immunity to Line Crosses

Shorts between tip-to-tip, tip-to-ring, or ring-to-ring involving two or more lines MUST NOT damage the E-DVA. Shorts between tip-to-ground or ring-to-ground involving one or more lines MUST NOT damage the E-DVA.

Reference: section 4.4.3 of [GR 909].

### I.2.3 System Generated Open Intervals

When in the loop closure state (off-hook), interruptions to loop current feed on the E-DVA MUST NOT exceed 100 ms.

Reference: section 4.4.5 of [GR 909].

Network Disconnect (or Loop Current Feed Open) is signaled by the network side of a loop start interface when the distant end releases while the CPE is offhook. Typically, this signal is used to notify electronic equipment, such as answering machines, that the caller has hung up. When provisioned to do so via the NetDisc date element, the E-DVA MUST remove DC bias for 1 second ±400 milliseconds when a call has been cleared by the network.

**Table I.2 – E-DVA Network Disconnect Signaling Event**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Increments | Default |
|---|---|---|---|---|---|---|---|---|---|
| NetDisc | Integer (ms) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER, E-DVA | 0 to 2000 | 100 | 1000 |

NetDisc value of 0 indicates that the E-DVA MUST NOT remove DC bias when a call disconnects. The default value of NetDisc should be 1000 milliseconds. The default NetDisc for Answer Signal should be "off".

### I.2.4 Open Switching Interval Distortion

The following are the Open Switching Interval Distortion requirements. When in the loop closure state and providing loop current feed, E-DVA loop current feed open commands of duration, T MUST have resolution ± 25 ms for $50 \leq T \leq 1000$ ms. When in the above state, the E-DVA MUST continue to maintain loop closure with no interruptions >1 ms.

- Loop current feed open MUST NOT exceed 5 s in duration.
- Loop current feed is an interruption of the loop current sourced on the drop.

[GR 909] specifies that these closure requirements MUST be satisfied for both on-hook and off-hook.

Reference: section 4.4.6 of [GR 909].

### I.2.5 Answer Supervision Signal (AnsSup)

Answer Supervision (also called battery reversal, reverse DC bias, or Reverse Loop Current Feed) is signaled when the distant end answers a call originated by the CPE. Typically, this signal is used to notify electronic equipment such as PBXs which have a local billing system that a call has been answered. When provisioned to do so via the AnsSup data element, the E-DVA MAY reverse DC bias when a call has been answered.

**Table I.3 – E-DVA Answer Supervision Event**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Increments | Default |
|---|---|---|---|---|---|---|---|---|---|
| AnsSup | Boolean | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER, E-DVA | Off/On | N/A | Off |

The default AnsSup value for Answer Signal should be "off".

### I.2.6 Dial Pulsing

Dial pulses MUST be collected at the E-DVA. The digits are gathered according to the digit map and all digits are sent in a single message. The E-DVA MUST support 8-12 pps with a 58-64% break.

Reference: section 4.4.9 of [GR 909].

### I.2.7 DTMF Signaling

The E-DVA MUST support the use of DTMF for both dialed digits and for the relay of digits as part of an established session. When dialing the DTMF, signaling MUST be collected at the E-DVA. The digits are gathered according to the digit map and all digits are sent in a single message.

The E-DVA MUST NOT amplitude overload at the maximum expected DTMF signal level per [ANSI T1.401]. ([ANSI T1.401] describes the maximum DTMF signal level.) Amplitude overload is any output frequency between 0-12 kHz at a power level greater than –28 dBm0, when the input frequency is between 600-1500 Hz at a power level equal to the maximum expected DTMF signal level.

The E-DVA MUST apply DTMF tones to the audio path, or the E-DVA MUST generate DTMF relay per [CODEC-MEDIA] as dictated from the negotiated SDP associated with the session.

The E-DVA MUST offer DTMF relay within SDP upon session origination as provisioned in the DTMF RELAY feature data element.

**Table I.4 – DTMF Relay Offer**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Increments | Default |
|---|---|---|---|---|---|---|---|---|---|
| DTMF RELAY | Boolean | Non-volatile | Per E-DVA | CONFIG. SERVER | CONFIG. SERVER | CONFIG. SERVER E-DVA | Off/On | N/A | ON |

The default value of DTMF_RELAY = ON instructs the E-DVA to offer DTMF relay within SDP upon session origination.

### I.2.8 Dialtone Removal

The E-DVA MUST remove dialtone within 250 ms of detecting the first dialed digit.

Subsequent digit analysis in accordance with the digit map may result in re-application of dialtone by the E-DVA. The requirement for dialtone removal also applies to such a re-application of the dialtone.

Note, however, that the act of re-applying the dialtone is a digit map action and independent of this requirement.

## I.3 General Ringing

### I.3.1 Alerting Signals

The E-DVA MUST support unbalanced or balanced ringing. The applied cadence MUST be within ±50 ms of the defined cadence. Nominal cadence has a 6-s period with 1.7 to 2.1 s ringing and 3.1 to 5.5 s of silence.

For Unbalanced Ringing, the alerting cadence is applied to ring with tip grounded. The DC component during ringing is such that the ring conductor is negative with respect to tip.

For Balanced Ringing, the alerting cadence is applied to both tip and ring, typically $180^{o}$ out of phase, with or without a DC component.

Reference: section 4.5.2 of [GR 909]. Modified for IPCablecom2 for optional balanced ringing.

### I.3.2 Ringing Delay

Ringing MUST be applied within 200 ms of the E-DVA receiving SIP INVITE with SDP. The cadence MUST be used as per PACM configuration entered at any point (i.e., the cadence may start with the silent period).

Reference: section 4.5.3 of [GR 909].

### I.3.3 Ringing Source

The E-DVA Ringing Source MUST meet the duration-limited source safety requirements of [GR 1089].

- The E-DVA ringing frequency MUST be 20 ± 1 Hz.
- The E-DVA ringing source DC component (offset) MUST be ≤ 75 Vdc.
- The E-DVA Ringing Source MUST meet 1.2 ≤ peak-to-rms voltage ratio ≤ 1.6.
- The E-DVA ringing source bridged C-weighted noise MUST be ≤ 90 dBrnC, when referenced to 900 ohms during ringing (i.e., the 20 Hz component < 0 dBm), and the analog voiceband lead conducted emissions criteria of [GR 1089].

Reference: section 4.5.4 of [GR 909].

### I.3.4 Ringing Capability

The minimum ringing voltage of the E-DVA MUST meet 40 Vrms across a 5 REN load on a drop with resistance ≤ $R_{DC}$ – 400 ohms.

Reference: section 4.5.5 of [GR 909].

### I.3.5 Ringing Capacity

The E-DVA MUST be capable of supporting 5 REN per analog line as described in [GR 909].

Reference: section 4.5 of [GR 909].

### I.3.6 Ring Trip

The E-DVA Ringing MUST be removed within 200 ms of detecting loop closure.

Reference: section 4.5.7 of [GR 909].

### I.3.7 Ring Trip Detect Delay

The E-DVA MUST be able to detect a ring trip within 300 ms.

Reference: section 4.5.8 of [GR 909].

### I.3.8 Ring Trip Immunity

E-DVA Ringing MUST NOT be tripped when a termination of 10 k ohms in parallel with 6 uF is applied between tip and ring.

E-DVA Ringing MUST NOT be tripped when a termination of 200 ohms is applied between tip and ring for ≤ 12 ms.

Reference: section 4.5.9 of [GR 909].

## I.4 Voice Grade Analog Transmission

The IPCablecom2 system utilizes digital transmission of voice signals to and from the DVA. The DVA converts between the digital voice signal on the IP network and the analog voice signal on the tip and ring loop. System impairments in the digital network, such as packet loss, can affect the voice signal but are outside the control of the DVA. Therefore, this clause defines the analog voiceband requirements of the DVA and assumes an error-free digital network.

These requirements are derived from the PSTN, which, in some cases, utilizes analog transmission from a headend central office switch to a customer. Typically, the reference point by which these requirements are measured is the middle of the switch (digital to analog). This reference point is referred to as the 0 Transmission Level Point (TLP) and could be thought of as any point in the digital portion of the network.

Note that these are not end-to-end analog requirements since they apply to a single digital to analog conversion point (a typical voice call will be analog at each end with a digital network connecting the two ends). The 0 TLP of the IPCablecom2 system is any point in the digital IP network. The digital IP network, for voice signal transmission purposes, extends all the way to the DVA where the digital to analog conversion occurs. These requirements only apply to the G.711 audio codec as specified in [CODEC-MEDIA]. Transmission requirements for the other compression algorithms specified in [CODEC-MEDIA] are not yet defined.

In general, all these requirements MUST be satisfied for both on-hook and off-hook parameters.

### I.4.1 Input Impedance

The E-DVA input impedance MUST meet:

- 600 ohms nominal
- ERL (echo return loss) > 26 dB (29 dB objective)
- SRL (singing return loss) > 21 dB (24 dB objective)

Reference: section 5.3.3 of [GR 909].

### I.4.2 Hybrid Balance

The E-DVA Hybrid Balance MUST meet, where LT1 is transmit loss and LR1 is receive loss at 1004 Hz:

- ERL > 21 dB (26 dB objective)
- SRL > 16 dB (21 dB objective)
- ERL = 15 + LT1 + LR1
- SRL = 10 + LT1 + LR1

Reference: section 5.3.4 of [GR 909].

### I.4.3 Longitudinal Balance

The E-DVA Longitudinal Balance MUST meet:

- 200 Hz: min > 45 dB, ave > 50 dB (ave > 61 dB objective)
- 500 Hz: min > 45 dB, ave > 50 dB (ave > 58 dB objective)
- 1000 Hz: min > 45 dB, ave > 50 dB (ave > 52 dB objective)
- 3000 Hz: min > 40 dB, ave > 45 dB

Reference: section 5.3.5 of [GR 909].

### I.4.4 E-DVA Loss

The E-DVA loss plan is part of a network loss plan, which considers not only the analog loss between end points, but also the end-to-end delay, the loopback delay, noise and echo cancellation. Guidance in setting the DVA loss can be found in [ANSI T1.508], [TSB-122a], and Table 1 of [TIA-912a], which defines various termination points across a network.

Additional consideration must be taken due to the short analog loop architecture with the DVA. In this configuration, there is a potential risk of G.711 codec overload with DTMF signaling. In this configuration, it is recommended that an additional loss in each direction (D/A and A/D) be configured in the DVA.

Additionally, variations in network deployments result in variations in the end-to-end and loopback delays. These delay variations must also be considered in setting the loss plan values.

Due to these considerations, for each telephony line, the DVA MUST support two provisioned loss parameters, one for the D/A direction (towards the subscriber) and one for A/D direction (from the subscriber).

The E-DVA MUST support a provisioning range of 0 dB to 12 dB of loss in 1 dB increments.

**Table I.5 – E-DVA Provisioned Loss Plan**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Increments | Default |
|---|---|---|---|---|---|---|---|---|---|
| D/A Loss | Integer (dB) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER, E-DVA | 0 to 12 | 1 | 6 |
| A/D Loss | Integer (dB) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER, E-DVA | 0 to 12 | 1 | 6 |
| NOTE – In loss planning, positive numbers represent loss and negative numbers represent gain. | | | | | | | | | |

### I.4.5 E-DVA Loss Tolerance

E-DVA Loss Tolerance MUST be within ±0.5 dB of the provisioned loss.

Reference: clause 6.5.4.1 of [TIA-912a].

### 1.4.6 Frequency Response

The E-DVA Off-hook transmission loss between 400-2800 Hz MUST be within –0.5 to +1 dB of the loss at 1004 Hz using a 0 dBm0 signal.

The E-DVA On-hook transmission loss between 400-2800 Hz MUST be within –1 to +2 dB of the loss at 1004 Hz using a 0 dBm0 signal (+ means more loss, – means less loss).

Reference: section 6.1.9 of [GR 57].

### 1.4.7 60 Hz Loss

The E-DVA transmission path loss at 60 Hz MUST be at least 20 dB greater than the off-hook transmission path loss at 1004 Hz. The intention is to limit the encoding of 60 Hz induction in the A/D direction.

Reference: section 6.1.10 of [GR 57].

### 1.4.8 Amplitude Tracking

The E-DVA deviation of a 1004 Hz off-hook transmission path loss relative to the loss of a 0 dBm0 input signal MUST meet:

- –37 to +3-dBm0 input: +/-0.5 dB max (+/–0.25 dB ave)
- –50 to –37-dBm0 input: +/-1.0 dB max (+/–0.5 dB ave)
- –55 to –50-dBm0 input: +/-3.0 dB max (+/–1.5 dB ave)

The E-DVA deviation of a 1004 Hz on-hook transmission path loss relative to the loss of a 0 dBm0 input signal MUST meet:

- –37 to 0 dBm0: +/–0.5 dB max

Reference: section 6.1.11 of [GR 57].

### 1.4.9 Overload Compression

The increase in the E-DVA off-hook transmission path loss at 1004 Hz relative to the loss of a 0 dBm0 input signal MUST meeting the following:

- +3 dBm0 input: ≤ 0.5 dB increased loss
- +6 dBm0 input: ≤ 1.8 dB increased loss
- +9 dBm0 input: ≤ 4.5 dB increased loss

This is to ensure the receiver off-hook signal can be transmitted.

Reference: section 6.1.12 of [GR 57].

### 1.4.10 Idle Channel Noise

The idle channel noise MUST NOT exceed 20 dBrnC at the output of the E-DVA (18 dBrnC objective).

Reference: section 6.1.13 of [GR 57].

### 1.4.11 Signal to Distortion

The E-DVA ratio of the output signal to output C-notched noise with a 1004 Hz input signal while providing an onhook and off-hook transmission path MUST meet:

- 0 to –30-dBm0 input: >33-dB ratio
- –30 to –40-dBm0 input: >27-dB ratio
- –40 to –45-dBm0 input: >22-dB ratio

Reference: section 5.3.15 of [GR 909] and section 6.1.14 of [GR 57].

### 1.4.12 Impulse Noise

The E-DVA impulse noise MUST meet:

- ≤15 impulses in 15 minutes with no holding tone applied at a threshold of 47 dBrnC0.
- ≤15 impulses in 15 minutes with a –13 dBm0 tone at 1004 Hz at a threshold of 65 dBrnC0.

These SHOULD be met for both the on-hook and off-hook transmission paths. For a line under test, other lines on the E-DVA SHOULD be active (off-hook, dialing, ringing, etc.).

Reference: section 5.3.16 of [GR 909] and section 6.1.15 of [GR 57].

### 1.4.13 Intermodulation Distortion

The E-DVA intermodulation distortion MUST meet:

- R2 > 43 dB using a –13 dBm0 input signal
- R3 > 44 dB using a –13 dBm0 input signal

R2 and R3 are the 2nd and 3rd order intermodulation products measured using the IEEE 743-1984 4-tone method.

Reference: section 6.1.16 of [GR 57].

### 1.4.14 Single Frequency Distortion

The E-DVA single frequency distortion MUST meet:

- Using a 0 dBm0 input signal between 0-12 kHz, the output between 0-12 kHz <-28 dBm0
- Using a 0 dBm0 input signal between 1004-1020 Hz, the output between 0-4 kHz <-40 dBm0

Reference: section 6.1.17 of [GR 57].

### 1.4.15 Generated Tones

The E-DVA generated tones MUST meet:

- <-50 dBm0 between 0-16 kHz.

Reference: section 5.3.20 of [GR 909].

#### 1.4.16 Peak-to-Average Ratio

The E-DVA peak-to-average ratio of transmission paths MUST meet:

- P/AR > 90 with a –13 dBm0 input level. On-hook and off-hook transmission paths.

Reference: section 6.1.19 of [GR 57].

#### 1.4.17 Channel Crosstalk

With a 0-dBm0 signal between 200-3400 Hz applied to a line, other lines on the E-DVA MUST meet <-65 dBm0 C-message weighted output between 200-3400 Hz.

Reference: section 5.3.22 of [GR 909] and section 6.1.20 of [GR 57].

### 1.5 Out of Service Requirements

Clause 7.1.7 of [RSTF], In-Service and out-of-service states, defines the conditions where the E-DVA determines a network availability state and uses one of several analog line supervisory tones (dial tone, re-order tone, etc.) to indicate to the end user or device the current network state when a connection is attempted (E-DVA off hook state).

In addition to supervisory tones, some end user devices (security systems) also determine network connection likelihood by detecting the analog telephony DC bias at the E-DVA telephony termination point. This technique continuously monitors the DC bias and the loss of DC bias is interpreted by the security system as an alarm state. This type of alarm service, therefore, also requires mechanisms to manage the analog telephony DC bias signal both in the E-DVA on-hook and off-hook state to indicate the current network availability state.

The goal must be to provide E-DVA telephony termination point conditions (DC bias and supervisory tone signals) consistent with historical PSTN services while also providing a method where planned or scheduled network or E-DVA operations (network maintenance, software downloads, reboots) do not cause unwanted or inappropriate security alarms.

Due to the fact that end user alarms are subject to the E-DVA and network availability states, including short term, planned outages, it is required to allow the service provider to provision various parameters related to network availability state including planned outages, signaling types, timer durations etc. to properly signal the current system state to the end user and the end user devices.

#### 1.5.1 E-DVA On-Hook State

In this E-DVA state, the DC bias is the signaling method to indicate the Network/E-DVA in/out-of-service state. The E-DVA MUST support provisioning of the On-Hook state DCbias. The Operator is able to provision planned, scheduled service times not to be signaled as an out-of-service state pending a maximum duration element.

DCbiasSig element enables/disables the DCbias management per provisioned values on a per telephony port basis.

The E-DVA MUST perform DCbias per DCbias provisioned elements with a DCbiasSign element value of 0.

A value of 1 indicates that the DCbias is not controlled by the provisioned elements.

DCbiasMax element sets the maximum period of time that a DCbias is to be maintained following an E-DVA reboot requiring an in-service State re-establishment per [RSTF]. The E-DVA MUST maintain DCbias following an E-DVA reboot requiring an in-service State re-establishment per [RSTF] for the time period indicated in the DCbiasMax element.

Upon any reset or reboot, the E-DVA SHOULD NOT remove DCbias from the telephony termination point for more than the Network Disconnect Interval (typically 1 second ±

400 milliseconds). The E-DVA MUST NOT remove DCBias for more than 5 seconds, as long as the operational AC or battery power supply to the E-DVA is maintained across such an initialization event. An E-DVA then MUST comply with the DCbiasMax element. Note that not every security system will accept a 5-second DCbias removal time without alarming. Therefore, it is important to minimize any outage time under any condition.

If the Network/E-DVA fails to re-establish the in-service state per [RSTF] during the DCbiasMax duration, the E-DVA MUST remove the DCbias from the telephony port when the DCbiasMax duration expires.

If the Network/E-DVA succeeds to re-establish the in-service state per [RSTF] during the DCbiasMax duration, the E-DVA MUST cancel the DCbiasMax resulting in the DCbias being maintained on the telephony port in support of normal telephony signaling requirements.

DCbiasHold element sets the period of time that a DCbias is maintained following an out-of-service state per [RSTF]. The E-DVA MUST maintain DCbias following an out-of-service state per [RSTF] for the period of time indicated in the DCbiasHold date element.

If the DCbiasHold duration expires, the E-DVA MUST remove DCbias from the telephony port.

If the Network/E-DVA succeeds to re-establish the in-service state per [RSTF] during the DCbiasHold duration, the E-DVA MUST cancel DCbiasHold resulting in the DCbias being maintained on the telephony port in support of normal telephony signaling requirements.

DCbiasEnable element sets a delay time period prior to reapplying DCbias on the E-DVA telephony port following the re-establishment of the in-service state per [RSTF] and following a DCbias removal. This avoids "race" conditions between the Network/E-DVA transitions from inappropriately signaling to the end user security system. The E-DVA MUST reapply DCbias on the telephony port following the re-establishment of the in-service state per [RSTF] and following a DCbias removal after the delay time period indicated by the DCbiasEnable element.

**Table I.6 – Network/E-DVA On Hook In/Out of Service**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Range | Default |
|---|---|---|---|---|---|---|---|---|
| DCbiasSig | Boolean | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER E-DVA | n/a | false |
| DCbiasMax | Integer (seconds) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER E-DVA | 0 to 2400 | 1200 |
| DCbiasHold | Integer (seconds) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER E-DVA | 0 to 1200 | 600 |
| DCbiasEnable | Integer (seconds) | Non-volatile | Per Line | E-DVA | CONFIG. SERVER | CONFIG. SERVER E-DVA | 0 to 60 | 5 |

**Considerations:**

1) During call processing states, the E-DVA MUST NOT remove DCbias from the telephony termination point for longer than the Network Disconnect Interval (typically 1 second ± 400 milliseconds).

2) The echo canceller in the E-DVA MUST be able to pass test 14 in [G.168] when a V-series low-speed (< 9.6 kbit/s) modem is used which does not send a 2100 Hz disable tone with phase reversals. This is not unique to E-DVA to home security systems but is reflective of compliance to ITU-T V.25 requirements for in band analog modem signaling.

### I.5.2 E-DVA Off Hook State

In this E-DVA state, In-Service and out-of-service states MUST be supported as per [RSTF].

Some E-DVA telephony termination ports may be used by security systems which may require the removal of DCbias to signal an alarm state. The enabling of the DCbiasSig element which enables/disables the DCbias management per provisioned values on a per telephony port basis will provide selective management of the DCbias signaling on a per telephony port basis.

All sub-elements of DCbiasSig MUST be supported if DCbiasSig is enabled.

### I.5.3 DTMF Signaling

Some Home Alarm systems use proprietary DTMF signaling protocols. These protocols assume DTMF decoders and encoders meet Telcordia or ETSI standards. This places specific requirements on the E-DVA with respect to DTMF relay. DTMF telephone-events MUST be fully played out by an egress gateway according to the duration specified in the event subject to an optional minimum play-out duration. The DTMF events MUST be provisioned on the E-DVA endpoint per the [CODEC-MEDIA] to reflect Telcordia [GR 506] section 15.4.8, DTMF Signal Duration R15-52. DTMF signals generated by an E-DVA MUST have a signal duration of 50 milliseconds.

### I.5.4 Expanded Network Service Outages

While services have been offered to provide operators with methods to minimize Home Security System alarms during scheduled or known periods of network un-availability, situations may still exist where it is desirable for the operator to further expand the DCbias durations beyond the provisioned values. Under these cases, the Operator may remotely direct the E-DVA to expand the current DCbias duration times for a single event so as to provide short-term maintenance flexibility while still maintaining Home Security System requirements.

## 1.6 Message Waiting Indicator

The E-DVA MUST follow the general requirements on the Message Waiting Indicator (MWI) given in [RSTF].

Upon receiving the NOTIFY message from the MWI Application Server, the E-DVA MUST present the corresponding MWI to the user's CPE device via a MWI tone, a MWI voice announcement, a MWI FSK signal, or a MWI DTMF signal, according to the provisioned UE MWI Tone Indication, UE MWI Voice Announcement Indication, UE MWI FSK Indication and UE MWI DTMF Indication data parameters in Table I.7. The following are additional requirements on MWI:

- The MWI FSK or DTMF signal is presented to the user's CPE device through the analog port on the E-DVA when the CPE device is on-hook. In presenting these signals, the E-DVA MUST follow the corresponding requirements in [GR 30] section 2.3.2, [SR-TSV-002476], [GR 1401], [GR 506], [EN 300 659-1] clause 6.2, and [EN 300 659-3] clause 5.2.2.
- The MWI tone or voice announcement MUST be presented to the user's CPE device through the analog port on the E-DVA when the CPE device goes off-hook.
- If the MWI arrives while the line is busy, the E-DVA MUST delay the presentation until the line goes back to the idle state.

The E-DVA can have built-in capabilities to present the MWI signals in a visual or audible format directly to the user. Such local capabilities are vendor-specific and are outside the scope of this Recommendation.

**Table I.7 – MWI Signal Types**

| Data | Type | Persistence | Scope | Stored by | Written by | Read by | Mandatory/ Optional |
|---|---|---|---|---|---|---|---|
| UE MWI Tone Indication | Boolean | Non-volatile | Per public user ID | CONFIG. SERVER | CONFIG. SERVER | UE | Mandatory |
| UE MWI Voice Announcement Indication | Boolean | Non-volatile | Per public user ID | CONFIG. SERVER | CONFIG. SERVER | UE | Mandatory |
| UE MWI FSK Indication | Boolean | Non-volatile | Per public user ID | CONFIG. SERVER | CONFIG. SERVER | UE | Mandatory |
| UE MWI DTMF Indication | Boolean | Non-volatile | Per public user ID | CONFIG. SERVER | CONFIG. SERVER | UE | Mandatory |

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