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SERIES V: DATA COMMUNICATION OVER THE TELEPHONE NETWORK

Interworking with other networks

Interworking between ITU-T T.38 and ITU-T V.152 using IP peering for real-time facsimile services

Recommendation ITU-T V.153

ITU-T

International Telecommunication Union

ITU-T V-SERIES RECOMMENDATIONS

DATA COMMUNICATION OVER THE TELEPHONE NETWORK

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T V.153

Interworking between ITU-T T.38 and ITU-T V.152 using IP peering for real-time facsimile services

Summary

Recommendation ITU-T V.153 defines service interworking between two IP domains, whereby one IP domain is using voiceband data over IP (VBDoIP) transport according to Recommendation ITU-T V.152 and the other IP domain is using facsimile relay over IP (FoIP) transport according to Recommendation ITU-T T.38. Two modes of operation are specified for the T.38-to-V.152 interworking function: native versus emulated interworking.

The T.38-to-V.152 interworking technology is subject of the user plane and typically located in IP-to-IP gateway equipment, like border routers or border gateways.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T V.153	2009-12-14	16

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

Recommendation ITU-T V.153

Interworking between ITU-T T.38 and ITU-T V.152 using IP peering for real-time facsimile services

1 Scope

[ITU-T V.152] describes the voiceband data (VBD) operation of voice-over-Internet protocol (VoIP) gateways, which may be abbreviated as VBDoIP. [ITU-T T.38] describes the facsimile packet relay operation of voice-over-Internet protocol (VoIP) gateways, which may be abbreviated as FoIP. Both these gateway models consider explicitly interworking between an IP-based packet-switched network on one side and a circuit-switched network on the other side.

This Recommendation describes procedures for direct service interworking (according to the definition in clause 3.2 of [ITU-T Y.1251]) of two IP domains, whereby one IP domain uses V.152-based VBDoIP transport and the other IP domain uses T.38-based FoIP transport.

The term voiceband data is an umbrella term for all kinds of teleservices that use a "data-oriented transport" in the frequency band of the narrow-band voice spectrum (which is a 3.1-kHz-band). The data-oriented transport is realized by modem protocols (the definition for modem can be found in clause 3.13 of [ITU-T V.152]), as defined, e.g., within the ITU-T V-series Recommendations. Teleservices may be categorized into three major applications areas: facsimile, text-based communication and general data services. The three VBD application areas may be summarized as (by using notation "application/transport"):

– **Facsimile/modem**: Gateway technologies for PSTN-to-IP interworking, see, e.g., [ITU-T V.152] for pass-through mode and [ITU-T T.38] for packet relay mode.
– **Text/modem**: Gateway technologies for PSTN-to-IP interworking, see, e.g., [ITU-T V.152] for pass-through mode and [b-ITU-T V.151] for packet relay mode.
– **Data/modem**: Gateway technologies for PSTN-to-IP interworking, see, e.g., [ITU-T V.152] for pass-through mode and [b-ITU-T V.150.1] for packet relay mode.

This Recommendation only considers facsimile/modem.

2 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.

[ITU-T H.245] Recommendation ITU-T H.245 (2008), *Control protocol for multimedia communication*.

[ITU-T H.248.1] Recommendation ITU-T H.248.1 (2005), *Gateway Control Protocol:* Version 3, including its Amendment 2 (2009).

[ITU-T H.323] Recommendation ITU-T H.323 (2006), *Packet-based multimedia communications systems*.

[ITU-T Q.3303.2] Recommendation ITU-T Q.3303.2 (2007), *Resource control protocol No. 3 – Protocol at the interface between a Policy Decision Physical Entity (PD-PE) and a Policy Enforcement Physical Entity (PE-PE) (Rw interface): H.248 alternative*.

[ITU-T T.30] Recommendation ITU-T T.30 (2005), *Procedures for document facsimile transmission in the general switched telephone network.*

[ITU-T T.38] Recommendation ITU-T T.38 (2007), *Procedures for real-time Group 3 facsimile communication over IP networks*.

[ITU-T V.152] Recommendation ITU-T V.152 (2005), *Procedures for supporting voice-band data over IP networks*, and its Corrigenda 1 (2005) and 2 (2006).

[ITU-T Y.1251] Recommendation ITU-T Y.1251 (2002), *General architectural model for interworking*.

[IETF RFC 2198] IETF RFC 2198 (1997), *RTP Payload for Redundant Audio Data*.

[IETF RFC 2733] IETF RFC 2733 (1999), *An RTP Payload Format for Generic Forward Error Correction*.

[IETF RFC 3261] IETF RFC 3261 (2002), *SIP: Session Initiation Protocol*.

[IETF RFC 3550] IETF RFC 3550 (2003), *RTP: A Transport Protocol for Real-Time Applications*.

[IETF RFC 3551] IETF RFC 3551 (2003), *RTP Profile for Audio and Video Conferences with Minimal Control*.

[IETF RFC 4566] IETF RFC 4566 (2006), *SDP: Session Description Protocol*.

[IETF RFC 4733] IETF RFC 4733 (2006), *RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals*.

3 Definitions

3.1 Terms defined elsewhere

The terms defined in clause 3 of [ITU-T V.152] and clause 3 of [ITU-T T.38] are applicable, as far as relevant, in this Recommendation. In addition:

3.1.1 voiceband data [b-ITU-T V.150.0]: The transport of modem signals over a voice channel of a packet network with the encoding appropriate for modem signals.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 emulated VBDoIP-to-FoIP mode: This is an internal mode of operation of the VBDoIP-to-FoIP gateway with an indirect interworking between both IP connection endpoints. This is done using a gateway that embeds internal TDM-based, 64-kbit/s bearer channels. The two (gateway local) IP connection endpoints do thus represent emulated ITU-T V.152 and ITU-T T.38 gateway functions.

3.2.2 facsimile packet relay mode ("fax relay" for short): The transport of facsimile/modem data across an IP-based packet network using [ITU-T T.38].

3.2.3 IP peering: IP peering denotes the interconnection of two IP domains (at the network protocol layer).

3.2.4 native VBDoIP-to-FoIP mode: This is an internal mode of operation of the VBDoIP-to-FoIP gateway with a direct interworking between both (gateway local) IP connection endpoints where no circuit-switched bearer technology is used internally in the gateway.

3.2.5 VBDoIP-to-FoIP gateway: A media gateway that is compliant with this Recommendation.

3.2.6 voiceband data mode [adapted from ITU-T V.152]: VBDoIP is the transport of voiceband data over a voice channel of an IP-based packet network with the encoding appropriate for modem signals as defined in [ITU-T V.152], clause 6.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

B2BUA	(SIP) Back-to-Back User Agent
BICC	Bearer Independent Call Control
CSN	Circuit-Switched Network
DS0	Digital Signal level 0
FoIP	Facsimile-over-IP
FoTDM	Facsimile-over-TDM
G3FE	Group 3 Facsimile Equipment
GSTN	General Switched Telephone Network
IMS	IP Multimedia System
IP	Internet Protocol
IPDV	IP Packet Delay Variation
IPLR	IP Packet Loss Ratio
IPTD	IP Packet Transfer Delay
ISDN	Integrated Services Digital Network
IWF	Interworking Function
MG	Media Gateway
MGC	Media Gateway Controller
NGN	Next Generation Network
NTE	Network Telephone Event
O/A	(SDP) Offer/Answer
PE-PE	Policy Enforcement Physical Entity
PES	PSTN Emulation Subsystem
PSTN	Public Switched Telephone Network
PT	(RTP) Payload Type/Packet Type
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol
SDP	Session Description Protocol
SIP	Session Initiation Protocol

SLA	Service Level Agreement
(S)TDM	(Synchronous) Time Division Multiplexing
TPKT	Transport Protocol Data Unit Packet
UA	(SIP) User Agent
UDP	User Datagram Protocol
UDPTL	Facsimile UDP Transport Layer (protocol)
VBD	Voiceband Data
VBDoIP	Voiceband Data-over-IP
VBDoTDM	Voiceband Data-over-TDM

5 Conventions

None.

6 Overview

This Recommendation considers real-time facsimile services in case of IP peering. The understanding of IP peering is here simplified to the peer model of an ITU-T T.38 domain ("FoIP" for fax-over-IP) with an ITU-T V.152 domain ("VBDoIP" for voiceband data-over-IP).

Figure 1 recalls again the two interworking models of [ITU-T T.38] and [ITU-T V.152].

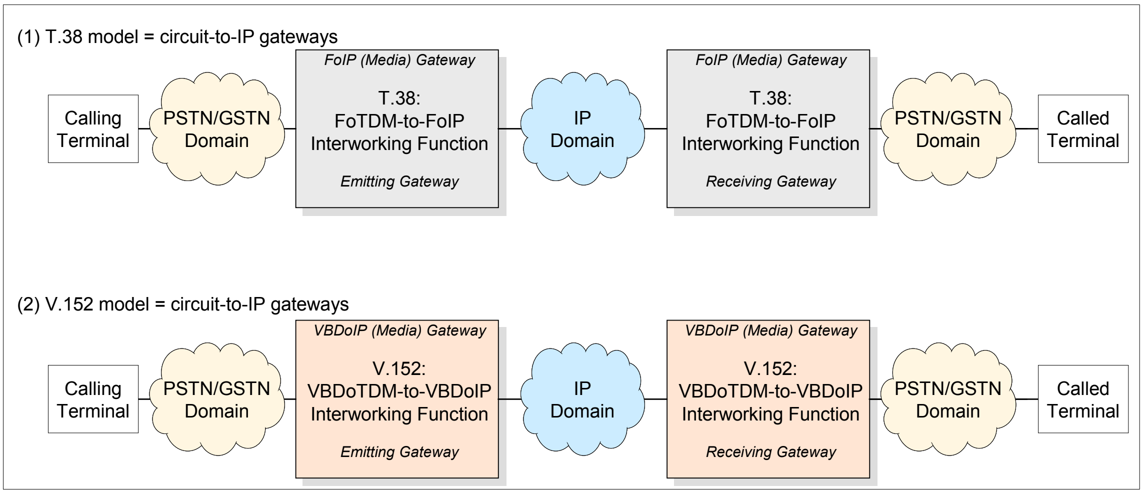

Figure 1 – Interworking between CSN and IP networks using T.38-to-T.38 and V.152-to-V.152 topologies

Both models consider explicitly interworking between an IP network on one side and a circuit-switched network (CSN) on the other side:

– ITU-T V.152: VBDoIP for PSTN-to-IP interworking.

– ITU-T T.38: FoIP for GSTN-to-IP interworking.

That means that an ITU-T V.152 gateway and an ITU-T T.38 gateway always have an IP interface and either an analogue line interface, or a digital 1 x 64 kbit/s synchronous TDM (STDM) interface.

In this Recommendation, "IP peering" denotes the interconnection of two IP domains (at the network protocol layer).

Each IP domain could support ITU-T V.152 only, or ITU-T T.38 only, or both, for the transport of real-time facsimile traffic. The interconnection of both IP domains is provided by an IP-to-IP gateway (e.g., like ITU-T NGN PE-FE, G.IP2IP, an ITU-T H.248 MG with an {IP, IP} connection model, or an ITU-T H.323 IP-to-IP gateway).

The cases when both IP domains are in ITU-T V.152 or ITU-T T.38 mode will result in a so-called media-agnostic and transport-agnostic IP-to-IP "interworking" (see also clause 3 in [ITU-T Q.3303.2]), thus they are not relevant to the scope of this Recommendation. The case with different modes of operation will lead to a V.152-to-T.38 interworking function (IWF) in the IP-to-IP gateway.

Such an IWF (illustrated in Figure 2) for facsimile in particular (or voiceband data in general) is fundamentally new due to the lack of a circuit-switched network segment (between the ITU-T V.152 and ITU-T T.38 service endpoints).

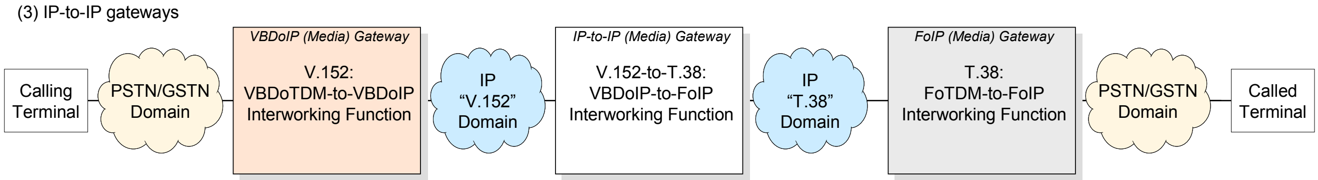

Figure 2 – Interworking between CSN and IP networks using a T.38-to-V.152 IWF

7 Definition of the principal modes of operation

V.152-to-T.38 interworking in the context of IP-to-IP means cascading of the two interworking functions for [ITU-T V.152] and [ITU-T T.38]. There are basically two possibilities of interworking.

7.1 Emulation mode

Emulation mode is the indirect V.152-to-T.38 interworking when a TDM domain is internal to the IWF, as shown in Figure 3.

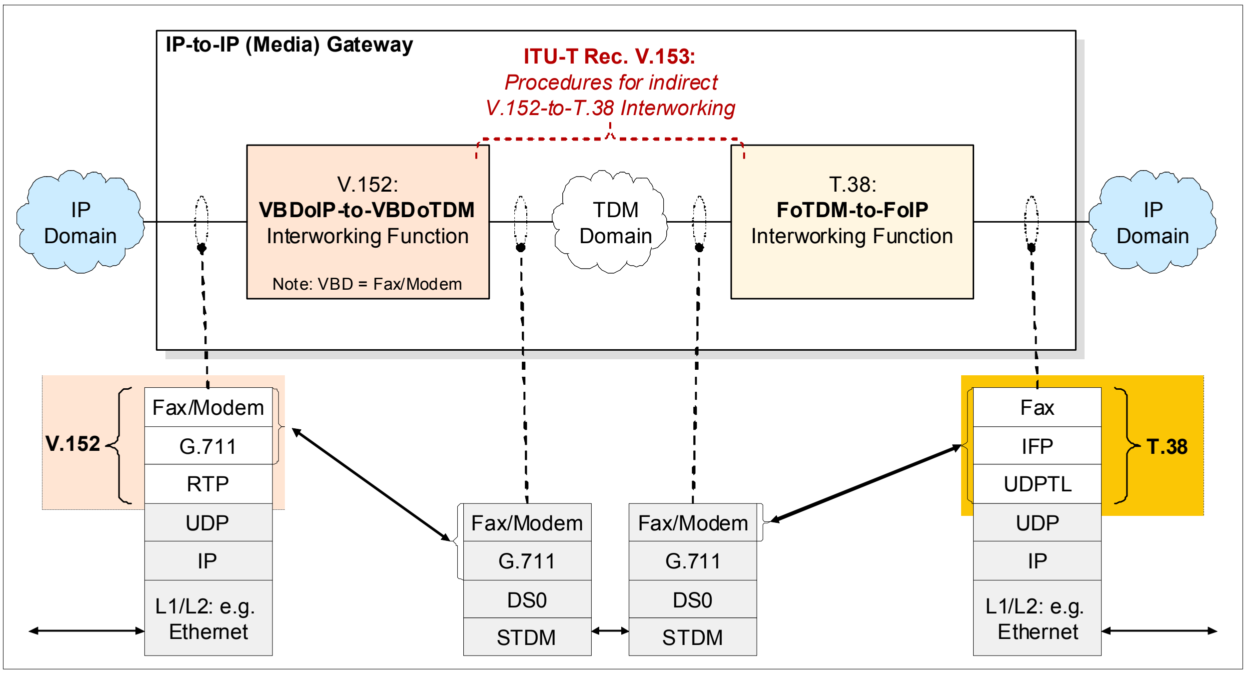

Figure 3 – Emulation approach – Indirect V.152-to-T.38 interworking via a TDM domain internal to the IWF

This interworking model requires the involvement of a "synchronous TDM" (STDM) domain due to the definition of both ITU-T Recommendations. Such an STDM domain would be located in an internal node.

7.2 Native mode

Native mode is the direct V.152-to-T.38 interworking where there is no TDM domain internal to the IWF, as shown in Figure 4.

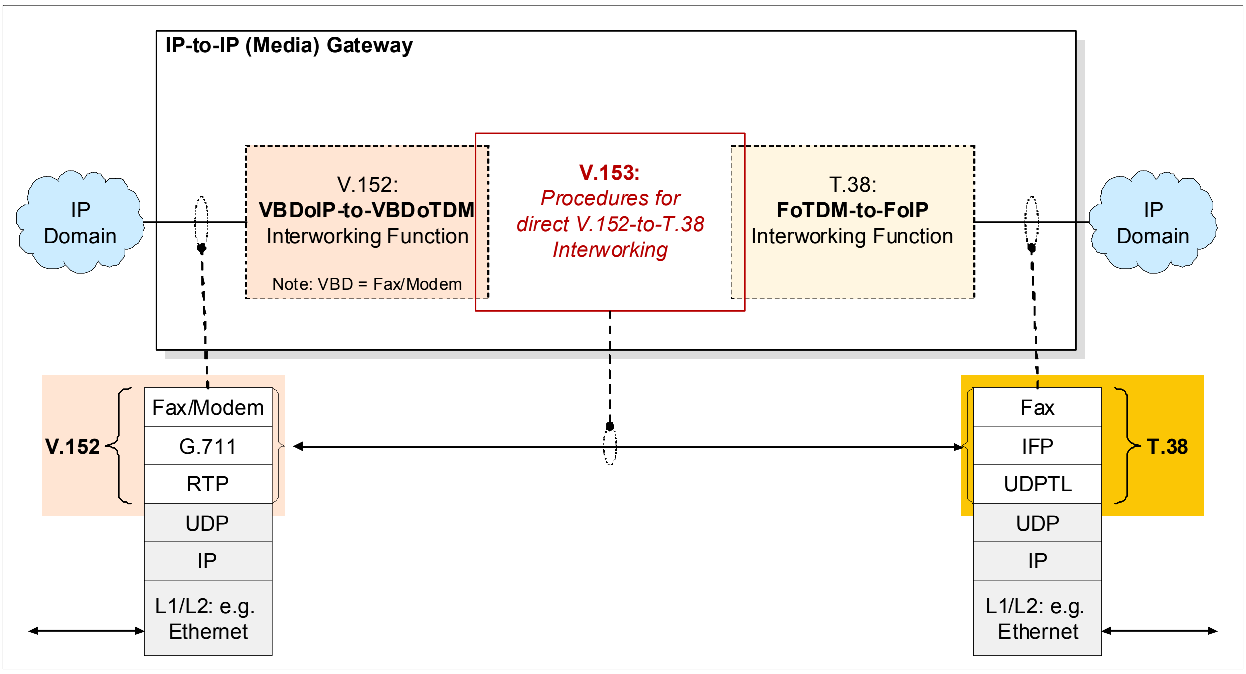

Figure 4 – Native approach – Direct V.152-to-T.38 interworking without a TDM domain internal to the IWF

7.3 Methods for discrimination between native and emulation mode

The node internal IWF interconnects always a "V.152 endpoint" and a "T.38 endpoint" (see also clause 9), independent of whether the native or the emulation mode is being used.

7.3.1 Mode discrimination via IWF control signalling (call-individual mode control)

Any call individual mode control must be linked to call/session control signalling. For instance, a call/session control server may decide during the call establishment phase, on the basis of domain specific information, supported gateway capabilities, SLA information, etc., which mode may be enforced.

NOTE – Such a method would be related to ITU-T H.248 signalling in case of ITU-T V.153-capable ITU-T H.248 media gateways. The protocol element for mode discrimination could be, e.g., a (new) ContextAttribute.

7.3.2 Mode discrimination via provisioning (call-independent mode management)

The enforced mode may be provisioned. A gateway would be then just supporting one mode, but not both. The applied mode would be independent of the call.

8 Interworking function: Specific items for consideration

8.1 ITU-T T.30 procedures

Handling of the ITU-T T.30 protocol shall be related to the "T.38 endpoint", and then according to [ITU-T T.38], since the ITU-T T.30 protocol is transparent for the ITU-T V.152 mode.

NOTE – The processing of T.30-over-T.38 information and T.30-over-V.152 information is entirely decoupled in the supposed basic model of interworking in the present release of this Recommendation. A future interactive model might be beneficial for enhanced interworking services. For example, adaptation mechanisms may be considered for the ITU-T T.38 side, influencing positively the ITU-T T.38 service by considering the service performance of ITU-T V.152 (e.g., information loss in the VBDoIP domain may feedback on ITU-T T.30/T.38 timer settings, ITU-T T.38 "spoofing", etc.).

8.2 Data rate management for ITU-T V.34 facsimile

Handling of ITU-T V.34 signals shall be related to the "T.38 endpoint", and then according to [ITU-T T.38] since ITU-T V.34 is transparent for ITU-T V.152-based communication.

9 Capability negotiation/determination for V.152-to-T.38 interworking

9.1 General

9.1.1 Capabilities of the two IP connection endpoints in the gateway

There are two IP connection endpoints involved in the IWF of the VBDoIP-to-FoIP gateway. Each endpoint represents an IP host function due to the termination of the IP layer and some higher layer protocols like the transport protocols and application level framing protocols. The VBDoIP-to-FoIP interworking function is thus representing a back-to-back IP host (B2BIH) configuration. The local IP addresses of each host (or IP connection endpoint) are gateway assigned IP addresses.

The capability configuration of each host follows fundamentally the specifications of [ITU-T V.152] for the "V.152 endpoint" and [ITU-T T.38] for the "T.38 endpoint".

9.1.1.1 V.152-to-T.38 interworking mode

The capability negotiation/determination process for the particular V.152-to-T.38 interworking mode is out of the scope of this Recommendation. The specific mode shall be dependent on the gateway implementation. It may be assumed that a gateway implementation supports the native mode, the emulation mode, or both.

The applied mode has just a gateway local scope (from the network perspective) and thus does not cause any interoperability issues. The control of the mode used is therefore beyond the scope of this Recommendation.

9.1.2 Capability parameterization

Negotiation of the support and use of V.152-to-T.38 interworking mode, as defined in this Recommendation, is carried out at call establishment (e.g., SIP session establishment or ITU-T H.323 call establishment in ITU-T V.152 and ITU-T T.38 domains) during the initial exchange of call capabilities of the endpoints establishing the call. Indication of such support entails:

– Indication of the media type (e.g., audio for ITU-T V.152 and image for ITU-T T.38 in case of SDP-based media descriptions).

– Indication of the transport protocol (e.g., UDP for ITU-T V.152, and UDP or TCP for ITU-T T.38).

– The application level framing protocol technologies (e.g., RTP for ITU-T V.152, and UDPTL, TPKT or RTP for ITU-T T.38). A gateway following this Recommendation shall not negotiate TPKT/TCP transport for ITU-T T.38.
– Assignment of transport port values.
– Assignment of RTP payload type values (PT) in case of ITU-T V.152 (using RTP profile "AVP" according to [IETF RFC 3551]).
– Assignment of media format specific information (e.g., like packetization time, use of forward error correction, etc.).

9.1.3 Capability negotiation

The mechanisms for negotiation vary depending on the endpoint's capabilities exchange protocols used, which can be the session description protocol (defined in [IETF RFC 4566]) or [ITU-T H.245]; the call control protocol, as defined in [ITU-T H.323], and the session initiation protocol (SIP), defined in [IETF RFC 3261]; and/or the media gateway control protocols as defined in ITU-T H.248 and ITU-T J.171.

Subsequent clauses describe negotiation procedures for mechanisms that use:

– session description protocol (SDP), defined in [IETF RFC 4566], such as (but not limited to) SIP terminals, SIP gateways and ITU-T H.248 gateways;
– [ITU-T H.245] that complies with [ITU-T H.323].

This Recommendation does not preclude gateways from negotiating support of other mechanisms for transporting non-voice signals, such as [IETF RFC 4733] telephone events, [b-ITU-T V.150.1], and/or [b-ITU-T V.151].

9.2 Negotiation using SDP

9.2.1 Used SDP information elements

9.2.1.1 VBDoIP (ITU-T V.152) local endpoint

For the purpose of this Recommendation, clause 7 of [ITU-T V.152] applies.

9.2.1.2 FoIP (ITU-T T.38) local endpoint

For the purpose of this Recommendation, Annex D.2.3 of [ITU-T T.38] applies.

9.2.2 Mechanisms for gateway control using the H.248 protocol

9.2.2.1 VBDoIP (ITU-T V.152) local endpoint

For the purpose of this Recommendation, clause 7.1 of [ITU-T V.152] applies.

9.2.2.2 FoIP (ITU-T T.38) local endpoint

For the purpose of this Recommendation, Annex E and Appendix III of [ITU-T T.38] apply.

9.2.3 Mechanisms for gateway control using the H.323 protocol

9.2.3.1 VBDoIP (ITU-T V.152) local endpoint

For the purpose of this Recommendation, clause 7.2 of [ITU-T V.152] applies.

9.2.3.2 FoIP (ITU-T T.38) local endpoint

For the purpose of this Recommendation, Annexes B and G, and Appendix II of [ITU-T T.38] apply.

9.2.4 Mechanisms for gateway control using SIP

9.2.4.1 VBDoIP (ITU-T V.152) local endpoint

For the purpose of this Recommendation, clause 7.1.2 of [ITU-T V.152] applies.

9.2.4.2 FoIP (ITU-T T.38) local endpoint

For the purpose of this Recommendation, Annex D of [ITU-T T.38] applies.

10 Handling of stimuli between VBDoIP and FoIP

Transitioning between operational modes of VBDoIP and FoIP connection endpoints (see clause 11) is triggered by stimuli information. Figure 5 illustrates the principal flows of stimuli information for an ITU-T V.153 gateway. There are dedicated stimuli, associated to the IP bearer-paths, for [ITU-T T.38] and [ITU-T V.152]. For instance, clause 9 in [ITU-T V.152] mandates the list of relevant VBD stimuli.

NOTE – The transport of stimuli in the IP bearer path may depend on the operational mode. For example, the default mode (if available) for [ITU-T T.38] and [ITU-T V.152] is audio VoIP and an in-band based stimuli transport: hence, stimuli encoding is identical to audio encoding. Stimuli transport in ITU-T T.38 FoIP mode is related to specific codepoints in ITU-T T.38 IFP packets (see clause 7 in [ITU-T T.38]). Stimuli transport in ITU-T V.152 VBDoIP mode may be either via a network telephone event (NTE) encoding according to [IETF RFC 4733], or in-band using the ITU-T V.152 VBD codec. The two possibilities lead to different RTP packet types with dedicated RTP payload type values.

There might be further stimuli issued via the control plane, i.e., originating in call control level decisions.

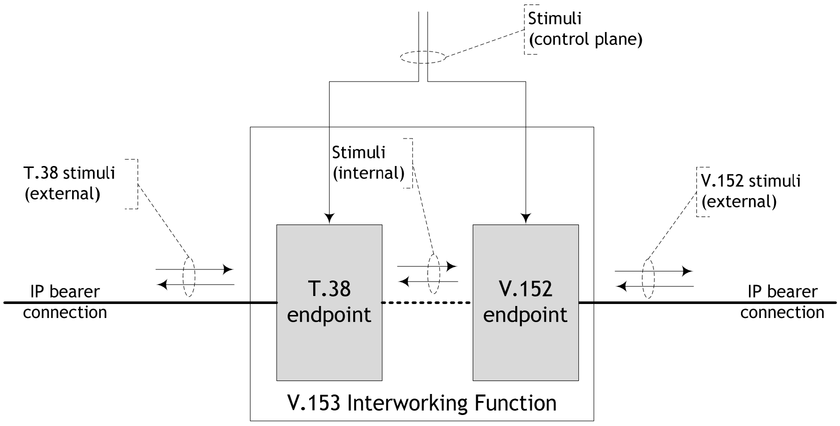

Figure 5 – Handling of stimuli between VBDoIP and FoIP

As it concerns internal handling of stimuli information by the ITU-T V.153 gateway, the recognition of (external) stimulus information in the IP bearer path implies a detection function. Detected stimuli on the ingress side by the ITU-T T.38 endpoint shall be provided to the internal ITU-T V.152 endpoint and vice versa. This approach should facilitate fast, unambiguous and synchronized state transitioning in both endpoints.

11 Synchronization of state transitioning between VBDoIP and FoIP state machines

There are two operational modes in [ITU-T V.152]: audio (VoIP) and voiceband data (VBDoIP). On its turn, [ITU-T T.38] also has two operational modes that can be classified as audio (VoIP) and facsimile packet relay (FoIP). The resulting state model for ITU-T V.153 gateways is illustrated in Figure 6. State transitioning between operational modes of the ITU-T T.38 endpoint and ITU-T V.152 endpoint is fundamentally triggered by stimuli (like VBD stimuli in case of [ITU-T V.152]); see also clause 10.

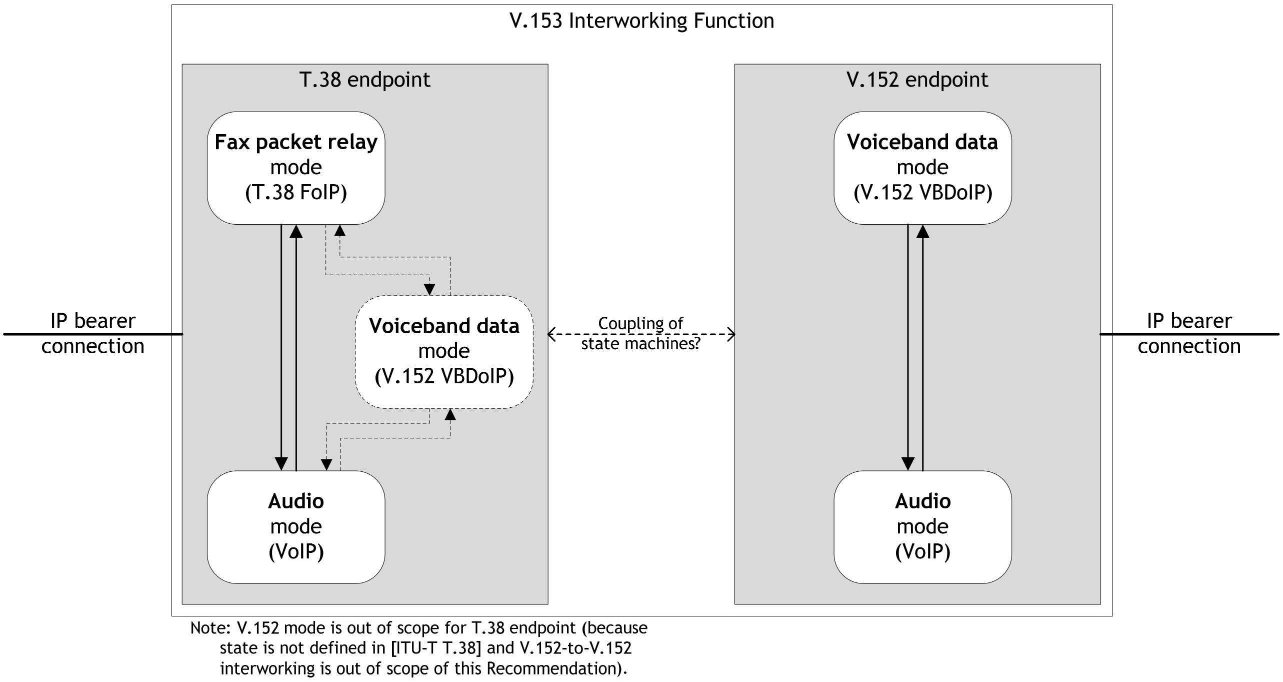

Figure 6 – Synchronization of state transitioning between VBDoIP and FoIP state machines

Synchronization of state transitioning in ITU-T V.153 gateways:

– ITU-T T.38 endpoint:
  - a state transitioning from audio to fax relay shall lead to a state transitioning from audio to VBD on the ITU-T V.152 side;
  - a state transitioning from fax relay to audio should lead to a state transitioning from VBD to audio on the ITU-T V.152 side (NOTE – The transitioning is optional because the VBD mode allows (limited) support of audio).

– ITU-T V.152 endpoint:
  - a state transitioning from audio to VBD shall lead to a state transitioning from audio to fax relay on the ITU-T T.38 side if the VBD stimuli is indicating fax/modem traffic;
  - a state transitioning from VBD to audio shall lead to a state transitioning from fax relay to audio on the ITU-T T.38 side (because the FoIP mode is not suited for audio traffic).

Appendix I

Performance evaluation of both modes of operation

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

From a user's point of view, the quality of the facsimile transmission service is dependent on a number of factors. The VBDoIP-to-FoIP gateway itself is contributing to the end-to-end QoS primarily on grade of service metrics: IP transfer delay (IPTD), IP packet loss ratio (IPLR) and IP packet delay variation (IPDV), due to the location of this gateway entirely within the IP network portion. The contribution to IPTD, IPDV and IPLR is discussed in clauses I.1, I.2 and I.3, respectively.

I.1 Gateway transfer delay

The transfer delay τ_{GW} of an VBDoIP-to-FoIP gateway may be separated into the two traffic direction specific one-way transfer delay metrics ($\tau_{GW,F2VBD}$ and $\tau_{GW,VBD2F}$). Each transfer delay represents the sum of all service times (e.g., like protocol layer Lx termination functions or the gateway interworking function) and all waiting times.

There is a significant difference between gateway transfer delays for the two modes of operation (native and emulated VBDoIP-to-FoIP modes). The emulated mode represents:

– a "low speed" infrastructure due to the 64-kbit/s transport capacity, and

– a "jitter-less" infrastructure due to synchronous TDM.

The IWF-internal TDM domain consequently adds further delay components for, e.g., packetization and dejittering. There might be further delay added depending on the IWF realization, e.g., packet loss concealment features.

The IP packets for VBDoIP and FoIP traffic usually use packetization times of 10 ms or higher. The IP packet delay variation (IPDV) in the IP domains is greater than zero and may be estimated, e.g., as a few milliseconds.

The following relation holds then between the gateway transfer delays for the two modes of operation:

$$\tau_{GW,Native} \approx \tau_{GW,Emulation} - \delta_{TDM}$$

The "TDM domain" specific delay component δ_{TDM} shall represent the sum of all the above indicated effects and may be for instance estimated to be greater than 10 ms (e.g., 15 ms) per direction.

The native mode has consequently a much lower gateway transfer delay than the emulation approach.

I.2 Gateway transfer delay variation

The VBDoIP-to-FoIP gateway could contribute to a reduction of the IPDV of the egress IP traffic by enforcing a traffic shaping function, of course at the expense of adding further transfer delay. Any explicit traffic shaping function is beyond the scope of this Recommendation.

It may be noted that the IWF-internal TDM domain in the emulation mode is inherently representing a traffic shaping function. It may be thus assumed that the IP packet delay variation of the outgoing IP traffic in emulation mode might be smaller than that in native mode ($IPDV_{GW,out,Emulation} < IPDV_{GW,out,Native}$).

I.3 Gateway information loss

The VBDoIP-to-FoIP gateway should not contribute to IPLR, independently of the mode of interworking. The gateway should consequently not lose or discard any packet node-internally.

I.4 Dejitter buffer aspects

Use of dejitter buffers impact fundamentally the one-way transfer delay of information.

I.4.1 Emulated VBDoIP-to-FoIP mode

[ITU-T V.152] has the requirement for a constant end-to-end transfer delay, which implies freezing the jitter buffer settings when entering the ITU-T V.152 mode. From a jitter buffer perspective, the emulated VBDoIP-to-FoIP mode should not cause any performance impact.

I.4.2 Native VBDoIP-to-FoIP mode

There is basically no requirement for dejittering in native mode due to the direct packet-to-packet interworking. In detail:

1) Traffic from the ITU-T T.38 domain to the ITU-T V.152 domain:

   The termination of ingress ITU-T T.38 packets does not require any dejitter buffer. Therefore, there should not be any dejitter buffer in that direction.

2) Traffic from the ITU-T V.152 domain to the ITU-T T.38 domain:

   The termination of ingress ITU-T V.152 packets implies a dejitter buffer, should the ITU-T V.152 protocol termination strictly follow [ITU-T V.152]. However, a dejitter buffer may be omitted if the ITU-T T.38 sender process is able to immediately process the incoming ITU-T V.152 traffic.

   NOTE – The ITU-T T.38 sender process typically expects a constant bit rate, 64-kbit/s signal in case of a digital PSTN access. The ITU-T V.152 domain provides the "access role" in ITU-T V.153 configurations, and there might be lost, too late or misinserted IP packets from the ITU-T V.152 side. This potential reduction in QoS of the VBDoIP signal (versus VBDoTDM) may demand further consideration for ITU-T T.38 encoders (for that mode, in ITU-T V.153 gateways).

I.5 Aspect of redundant packet transport

Any kind of redundant packet transport should fundamentally minimize the observed IPLR.

I.5.1 Transport redundancy in ITU-T V.152 domain

Redundant packet transport in ITU-T V.152 domains must follow [IETF RFC 2198], see clause 6 in [ITU-T V.152]. This redundancy method is independent of the dejitter buffer discussions in clause I.4, and does not affect the question whether a dejitter buffer should be used or not in the V.152-to-T.38 direction.

I.5.2 Transport redundancy in the ITU-T T.38 domain

Redundant packet transport in ITU-T T.38 domains is inherent to the applied ITU-T T.38 transport mode:

– **T.38-over-UDPTL/UDP**: redundancy mechanism according to clause 9.1.4.1 of [ITU-T T.38].
– **T.38-over-RTP/UDP**: redundancy mechanism according to [IETF RFC 2198], see clause 9.2 in [ITU-T T.38].
– **T.38-over-TPKT/TCP**: TCP provides an inherent "on request redundancy" by retransmitting unacknowledged TCP packets.

As in clause I.5.1, none of the above redundancy methods imply the need for a dejitter buffer.

Appendix II

H.248 bearer establishment procedure examples

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

II.1 Introduction

This appendix describes examples of the procedures for Internet-aware facsimile and voiceband data gateways conforming to this Recommendation to establish calls between ITU-T V.152 and ITU-T T.38 network domains. The decomposed gateway model follows [ITU-T H.248.1].

II.2 MG state transitioning: MGC-strict controlled method versus MG autonomous transitioning

Appendix III of [ITU-T T.38] defines two methods for state transitioning of audio/T.38 endpoints implemented in PSTN-to-IP ITU-T H.248 media gateways. This Recommendation only considers the MGC-controlled ITU-T T.38 transitioning behaviour (see clause II.4.2.1).

NOTE – The underlying ITU-T H.248 connection model (for ITU-T H.248 gateways compliant to this Recommendation) relates to an ITU-T H.248 context with two IP terminations.

II.3 Example network model

II.3.1 ITU-T H.248 decomposed gateway model

The technology defined by this Recommendation is required for interworking between ITU-T V.152 and ITU-T T.38 IP network domains. Figure II.1 illustrates such an example end-to-end scenario with a V.152-to-T.38 gateway as peering node between the two IP networks. The two Group 3 fax equipment (G3FE) terminals are behind PSTN access networks.

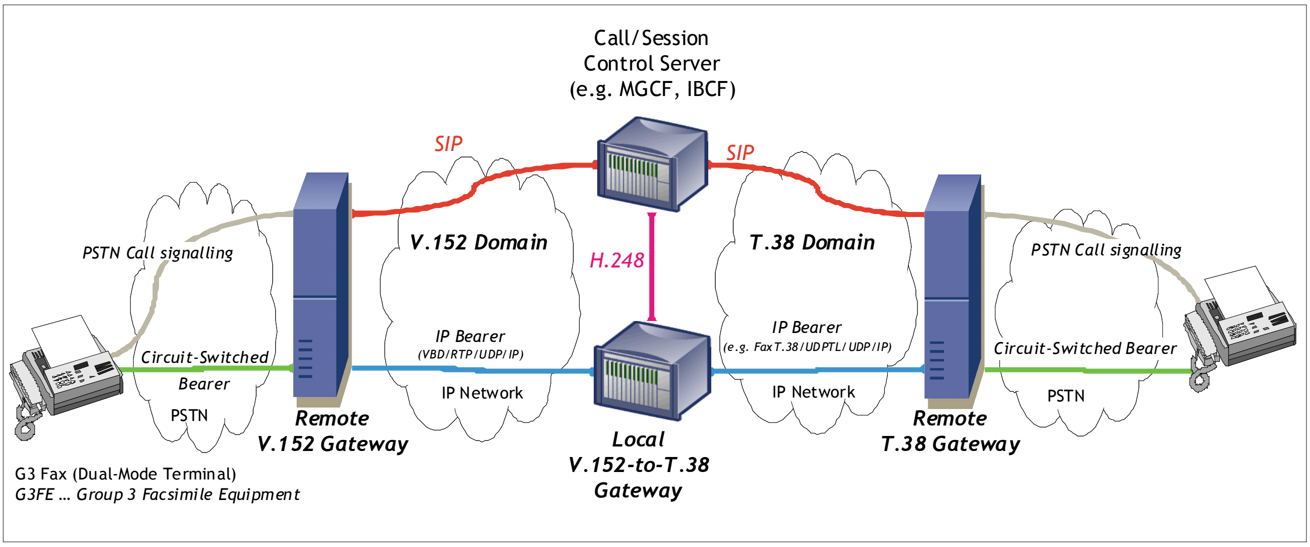

Figure II.1 – Typical decomposed gateway model as interworking point between an ITU-T V.152 domain and an ITU-T T.38 domain

The (local) V.152-to-T.38 gateway is thus between a remote ITU-T V.152 (PSTN-to-IP) gateway [ITU-T V.152] and a remote ITU-T T.38 (PSTN-to-IP) gateway [ITU-T T.38].

II.3.2 Example media capability negotiation process on call/session control level

Assume SIP is the call/session control protocol in the IP network, i.e., between the local and the two remote gateways. The media and bearer capability negotiation procedures are therefore based on the

SDP offer/answer (O/A) model (as per [b-IETF RFC 3264]); see also Figure II.2. The O/A capability negotiation is tied to call/session control signalling. ITU-T H.248 uses a different model for capability negotiations, namely the resource reservation procedures according to clause 7 of [ITU-T H.248.1].

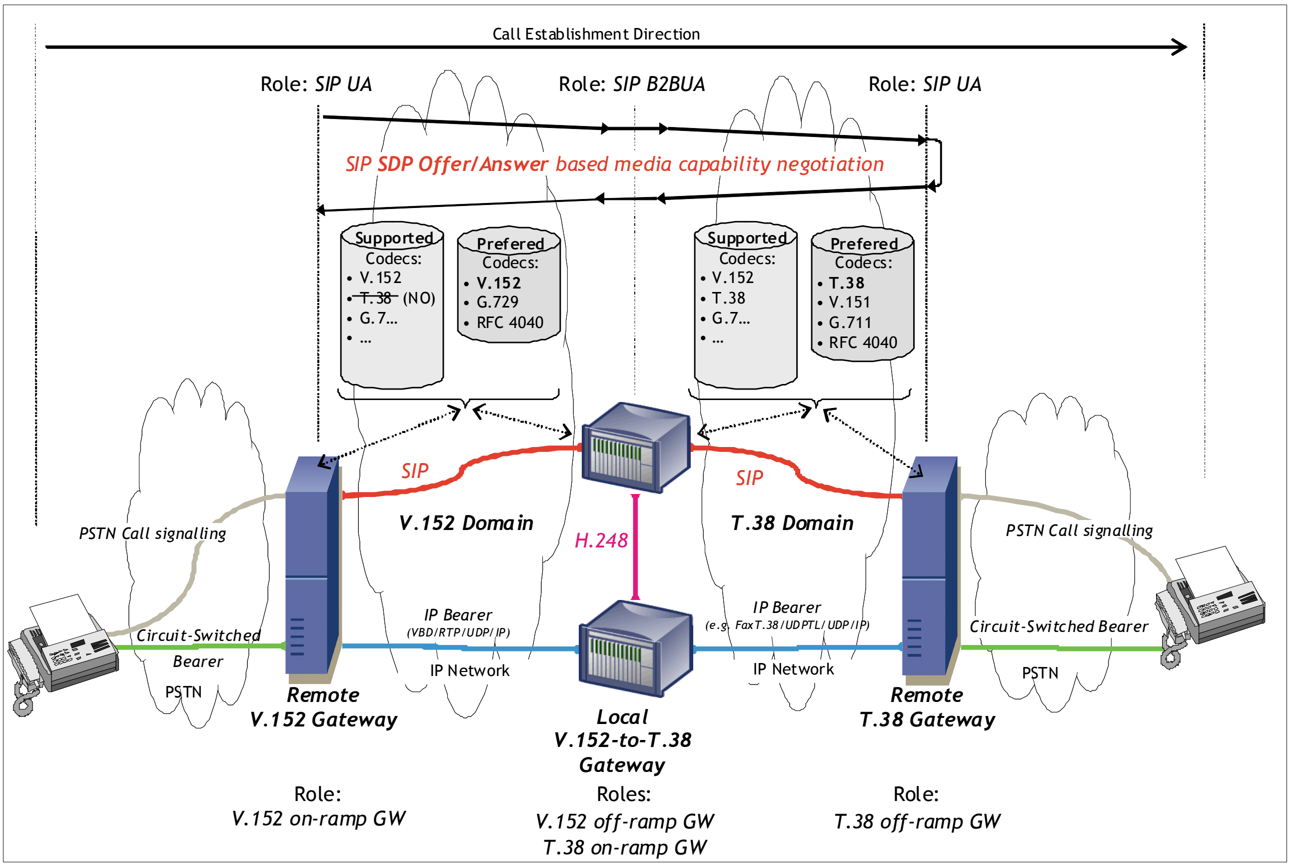

Figure II.2 – End-to-end media capability negotiation across the two IP domains – Example with a one-stage SDP offer/answer cycle between the two remote PSTN gateways

The V.152-to-T.38 interworking function will be enforced in the local gateway due to the example scenario of Figure II.2.

The "end-to-end" capability negotiation process is based on "codec lists" that are associated to a domain (e.g., preferred codecs by a service/network provider), to call/session control servers (e.g., supported codecs by controlled transport nodes like media gateways, media servers, etc.) and to the equipment which sources/sinks the media flows (in this example, the PSTN gateways from a SIP capability negotiation perspective).

The remote PSTN gateways provide SIP UA behaviour. The local gateway provides a SIP B2BUA function. The SDP capabilities are negotiated between the SIP UA entities.

The call is originated in the left hand side G3 fax device. The left hand side IP domain prefers ITU-T V.152 (instead of ITU-T T.38) for facsimile, e.g., due to fairly good QoS figures of this network domain (e.g., an IPLR below 0.5% due to an underlying QoS enhanced MPLS network). The remote ITU-T V.152 on-ramp gateway then generates a SIP INVITE containing an SDP offer with an audio codec and an ITU-T V.152 VBD codec, due to the supported codec list, which misses the ITU-T T.38 codec for facsimile, and the preferred codec list with ITU-T V.152 for all kinds of voiceband data services.

The SIP INVITE is then processed by the local gateway, which modifies the forwarded SDP offer by replacing ITU-T V.152 with ITU-T T.38 (due to the preference of ITU-T T.38 for facsimile in this IP domain). The replied SDP answer message then successfully acknowledges the offered media formats in this example.

The MGC function in the local gateway may then create an ITU-T H.248 context (see Figure II.3) with the selected audio codec(s) and the V.152-to-T.38 interworking function.

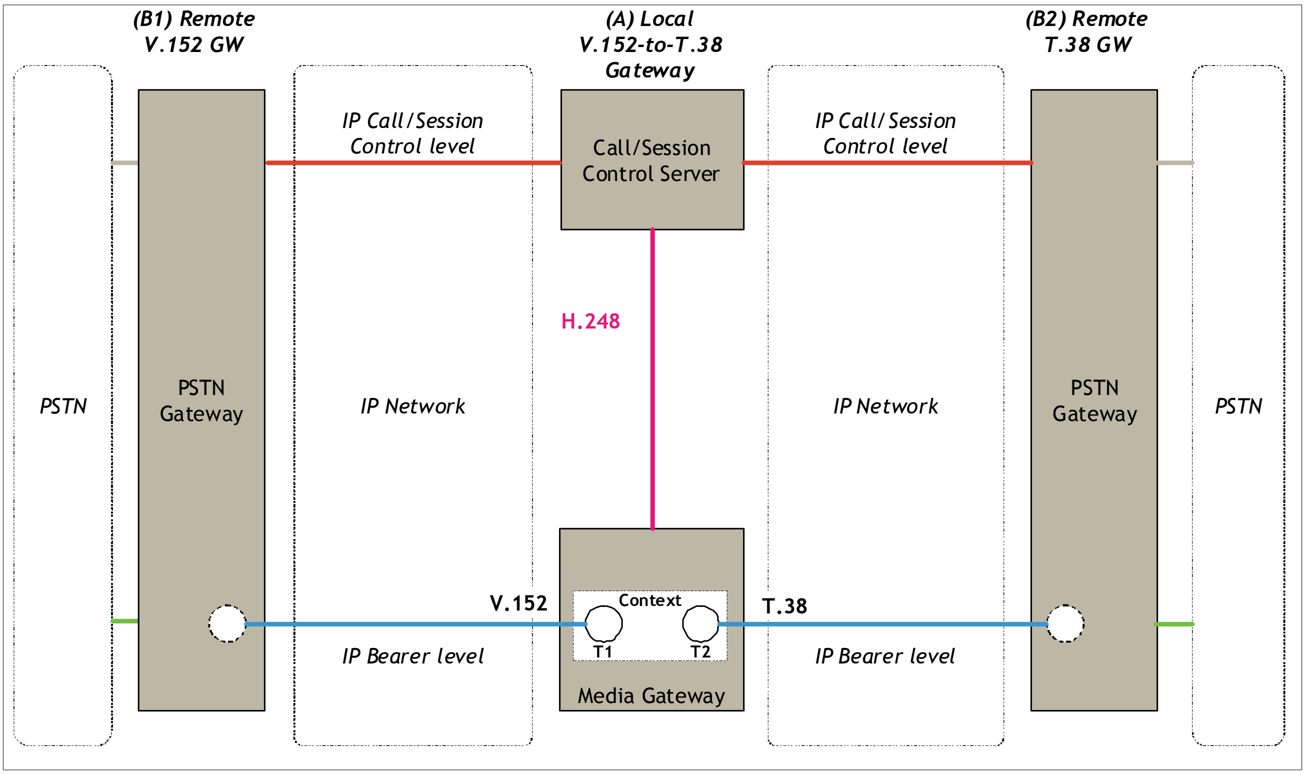

Figure II.3 – Consideration of the local V.152-to-T.38 gateway –
Example of an ITU-T H.248 decomposed gateway model

The ITU-T H.248 decomposed model for the local gateway in Figure II.3 is just an example. The remote PSTN gateways might be again an ITU-T H.248 gateway type (e.g., following [b-ETSI ES 283 002] for residential/access gateways or [b-3GPP 29.332] for IMS/PES trunking gateways), or an ITU-T H.323 gateway or a SIP voice gateway (following [b-ETSI TS 182 012]). For the purposes of this Recommendation, the deployed IP call/session control protocol (like SIP, SIP-I, BICC, ITU-T H.323) must support capability negotiation methods for exchanging at least audio, ITU-T V.152 and ITU-T T.38 codec information.

II.4 Example signalling

II.4.1 Auditing supported capabilities

At some point before a call, the media gateway controller will have audited the supported capabilities of his associated media gateways (see also Appendix III of [ITU-T T.38]). The codec related information is then stored in the "list of supported codecs" (which may actually be a list of following tuples {media type, media format, media attributes and default parameter values for this media format}).

The information of supported MG capabilities (including supported codecs) may be alternatively provisioned at the MGC/SIP B2BUA level (in case of SIP-based call/session control).

Later MG capability changes may be indicated by ServiceChange procedures.

II.4.2 Creating a V.152-to-T.38 Context

The creation of the V.152-to-T.38 interworking function relates to the creation of a corresponding ITU-T H.248 context in the local media gateway. The signalling events correspond to ADD.request and Modify.request commands for the two H.248 (IP) ephemeral terminations. It may be emphasized again that there is not any ITU-T H.248 physical termination (Note) in this context.

NOTE – There are ITU-T H.248 contexts of type physical-to-IP in the remote peering nodes in case of ITU-T H.248 gateways. The physical termination typically provides circuit related functions like (electrical) echo cancellation, gain control, etc. It may thus be noted that the local gateway misses the usual tdmc package related functions.

Below examples depict the context creation phase, as well as subsequent event detections and state transitioning actions.

II.4.2.1 V.152-to-T.38 context and ITU-T T.38 MGC controlled transitioning method

Table II.1 provides example stream descriptors for the two added ITU-T H.248 terminations. Here it is assumed that the MGC function in the local gateway does not decide on a per-call basis whether the ITU-T T.38 autonomous transitioning method, or whether the ITU-T T.38 MGC controlled transitioning method is to be applied. Rather, it is assumed that the MGC function always applies the MGC controlled transitioning method.

The MGC controlled transitioning method implies that the local MG must support ITU-T H.248.2 protocol capabilities (primarily for reporting detected stimuli in the IP bearer-path).

Consider the example of an alternate speech/fax service composed of the three call phases of audio, facsimile transmission and switch back to audio again.

Five steps highlight the major ITU-T H.248 signalling information. The first step is related to the entire creation of the ITU-T H.248 context, the establishment of the ITU-T H.248 stream and the bearer preparation for audio. The two subsequent steps are mid-call activities related to the start of fax transmission, and the last two steps describe the transition back to audio, after a successful fax transmission.

Step 1 (Table II.1): request/reply cycle for the addition of two new IP terminations into a new context. It should be noted that there is no further capability (codec) negotiation required over the ITU-T H.248 interface since the MGC is aware of the capability negotiation at SIP level. The MG issues ADD.request commands to reflect the selected codec decisions for the two media categories of audio and facsimile/modem.

Table II.1 – Example ITU-T H.248 stream descriptors – Creation of a V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 1

ITU-T H.248 encoding (shortened command)	Comment

1) Request (MGC to MG):
MEGACO/2 [11.9.19.65]
…
Add = ip/2/$/$ { ; IP "V.152" Termination
  Media {
   Stream = 1 { ; there is just one Stream per Term.
    LocalControl{
     ipdc/realm = "providerX.com"
         ; IP network indication (here "V.152 domain")
     Mode=SendReceive,
     ReservedGroup = OFF,
     ReservedValue = OFF ; because just single
                          ; audio codec
    },
    Local{
     v=0
     c=IN IP4 $
     m=audio $ RTP/AVP 8 101 111
     a=maxmptime:20 - 30
     a=rtpmap:101 telephone-event/8000 ; RFC 4733/4
     a=rtpmap:111 PCMA/8000   ; ITU-T V.152
     a=gpmd:111 vbd=yes
    },
    Remote{ ; Remote descriptor might also be sent in
             ; a later Modify request
     v=0
     c=IN IP4 19.70.3.2
     m=audio 54530 RTP/AVP 8 101 111
     a=maxmptime:20 - 30
     a=rtpmap:101 telephone-event/8000 ; RFC 4733/4
     a=rtpmap:111 PCMA/8000   ; ITU-T V.152
     a=gpmd:111 vbd=yes
    }
   }
  },
  Events = 1234 {ctyp/dtone} ; MGC requests H.248.2
                             ; ctyp/dtone event
                             ; notification
},
Add = ip/8/$/$ { ; IP "T.38" Termination
  Media {
   Stream = 1 { ; there is just one Stream per Term.
    LocalControl{
     ipdc/realm = "providerY.com"
         ; IP network indication (here "T.38 domain")
     Mode=SendReceive,
     ReservedGroup = OFF,; one media group
     ReservedValue = OFF ; just one audio codec, might
                         ; also be ON in case two or
                         ; audio codecs are requested
                         ; in 'audio' media descr.
    },
    Local{
     v=0 ; Single Media Group "audio flow"
     c=IN IP4 $
     …
     m=audio $ RTP/AVP 8 127
     a=rtpmap:127 telephone-event/8000
     a=ptime:20
    },
    Remote{
     v=0 ; Single Media Group "audio flow"
     c=IN IP4 12.9.19.65
     …
     m=audio 100 RTP/AVP 8 127
     a=rtpmap:127 telephone-event/8000
     a=ptime:20
    }
   }
  }
}
	IP "V.152" termination:
	In this example, the MGC requests (from the local MG) a PCMA audio codec with telephone-events and a PCMA VBD codec.
	The Reserve property values are false due to single group and single "media format" for Stream 1 (NOTE – RFC 4733/4734 and V.152 are supplementary media formats with regard to the audio format, see clause 7.1.7.1.3 of [ITU-T H.248.1]).
	Local Descriptor:
	The MGC selects RTP PT equal to 111 for the VBD codec due to MGC provisioning. Ditto for RFC 4733/4734 codec.
	The maxptime attribute is used in this example due to different packetization times in each state.
	Remote Descriptor:
	The MGC generates the RD (and LD) based on the SDP O/A process, which corresponds to the offered audio and *VBD* codec from the remote PSTN gateway. The MGC is aware that the remote gateway is ITU-T V.152 compliant (due to ITU-T V.152 SDP in the received SIP offer).
	Events descriptor:
	The MGC subscribes for the ITU-T H.248.2 ctyp/dtone event on the "V.152" IP termination (Note) to be notified in case (fax) modem specific events are detected.
	IP "T.38" termination:
	The Reserved Group property value is Off as the MG requests to reserve resources only for the PCMA audio codec.
	ITU-T T.38 specific resources will be reserved and allocated later on during the actual MGC controlled transitioning (see stream modification by Step 3 – Table II.3).

Table II.1 – Example ITU-T H.248 stream descriptors – Creation of a V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 1

ITU-T H.248 encoding (shortened command)	Comment

2) Reply (MG to MGC):
MEGACO/2 [11.9.19.70]
…
Add = ip/2/2/1 { ; ***IP "V.152" Termination***
Media {
Stream = 1 { ; there is just one Stream per Term.
Local{
v=0
c=IN IP4 19.70.27.4
m=**audio** 40008 **RTP/AVP** 8 101 **111**
a=maxmptime:20 - 30
a=rtpmap:101 telephone-event/8000 ; RFC 4733/4
a=rtpmap:111 PCMA/8000 ; ITU-T V.152
a=gpmd:111 vbd=yes
},
Remote{ ; Remote descriptor might also be sent in
; a later Modify request
v=0
c=IN IP4 19.70.3.2
m=**audio** 54530 **RTP/AVP** 8 101 **111**
a=maxmptime:20 - 30
a=rtpmap:101 telephone-event/8000 ; RFC 4733/4
a=rtpmap:111 PCMA/8000 ; ITU-T V.152
a=gpmd:111 vbd=yes
}
}}},
Add = ip/8/3/2 { ; ***IP "T.38" Termination***
Media {
Stream = 1 { ; there is just one Stream per Term.
Local{
v=0 ; **Single Media Group** "audio flow"
c=IN IP4 12.9.4.6
…
m=**audio** 40120 **RTP/AVP** 8 127
a=rtpmap:127 telephone-event/8000
a=ptime:20
},
Remote{
v=0 ; **Single Media Group** "audio flow"
c=IN IP4 12.9.19.65
…
m=**audio** 100 **RTP/AVP** 8 127
a=rtpmap:127 telephone-event/8000
a=ptime:20
}
}}}
	The two ADD reply commands do successfully acknowledge the requested media capabilities and stream configurations.

NOTE – It may be noted that the ITU-T H.248.2 event is associated to the ITU-T V.152 side termination and not the ITU-T T.38 side termination since after the autonomous transition to the ITU-T V.152 this termination may reliably detect corresponding fax modem related events – even in case compressing audio codecs had been requested in the initial Add.request.	

Step 2 (Table II.2): request/reply cycle, initiated now by the MG due to detected events. This event notification will be the trigger for the MGC for starting step 3.

Table II.2 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 2

ITU-T H.248 encoding (shortened command)	Comment
3) Notification Request (MG to MGC): MEGACO/2 [11.9.19.70] … **Notify** = ip/2/2/1 { ; ***IP "V.152" Termination*** ObservedEvents = 1234 {20081203T12101025 : ctyp/dtone{dtt=V21flag}} }	The "V.152" side IP termination may additionally report further observed events, e.g., regarding CNG or CED tone detection before reporting detection of ITU-T V.21 flags. Corresponding notification requests are not shown here. These events may be received and observed either in-band (possibly after the autonomous transition to VBD) or out-of-band via RFC 4733/4734 NTE events.
4) Notification Reply (MGC to MG): MEGACO/2 [11.9.19.65] … Notify = ip/2/2/1	

Step 3 (Table II.3): request/reply cycle for modifying the two stream endpoints. The first MODIFY.request command is necessary for disabling the event detection logic, associated on the ITU-T V.152 side. The second MODIFY.request command creates and configures the local ITU-T T.38 endpoint.

It may be noted that the ITU-T T.38 packet flow as well as the previously established ITU-T G.711 audio flow share both the same ITU-T H.248 stream (which is identified by the value '1'). Actually, there are three transport flows carried by that stream: PCMA/RTP media flow, RTCP control flow and ITU-T T.38 UDPTL flow. The three flow components are discriminated by three separate IP transport addresses. The RFC 4733/4734 packet traffic relates to a sub-flow component, sharing the same transport address with RTP audio, but uses a different payload type codepoint (values '127' and '8' respectively).

Table II.3 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 3

ITU-T H.248 encoding (shortened command)	Comment

5) Modification Request (MGC to MG):
MEGACO/2 [11.9.19.65]
…
Modify = ip/2/2/1 { ; ***IP "V.152" Termination***
Events
},
Modify = ip/8/3/2 { ; ***IP "T.38" Termination***
Media {
TerminationState {
ipfax/faxstate = Negotiating ; initial fax state
},
Stream = 1 { ; there is just one Stream per Term.
LocalControl{
ipdc/realm = "providerY.com"
; IP network indication (here "T.38 domain")
Mode=SendReceive,
ReservedGroup = OFF, ; one media group
ReservedValue = OFF ; just one media format t38
},
Local{
v=0 ; **Media Group** "packet relay flow for fax"
c=IN IP4 $
m=**image** $ **udptl t38**
a=T38FaxVersion:1
a=T38FaxRateManagement:transferredTCF
a=T38FaxUdpEC:t38UDPFEC
a=T38FaxMaxBufferSize:2000
a=T38MaxDatagram:512
a=T38MaxBitRate:14400
	IP "V.152" termination:
	MGC clears ctyp/dtone event subscription.
	
	IP "T.38" termination:
	MGC modifies the IP termination with a T.38 specific session/media description. The MGC generates the RD based on the SDP O/A process. Note that the RD may also be sent by the MGC in an additional subsequent modification request (depending on when the remote address and media information is available).
	MGC sets the faxstate property to the initial value 'Negotiating' and subscribes for the 'faxconnchange' event to ensure notification in case the end-of-fax event is observed.
	The applied T.38 transfer mode is based on UDPTL/UDP/IPv4 transport in this example.

Table II.3 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 3

<table>
<tr><th>ITU-T H.248 encoding (shortened command)</th><th>Comment</th></tr>
<tr><td><pre>
      (… additional T.38 attributes may be included)
     },
     Remote{
      v=0 ; Media Group "packet relay flow for fax"
      c=IN IP4 12.9.19.65
      ..
      m=image 102 udptl t38
      a=T38FaxVersion:1
      a=T38FaxRateManagement:transferredTCF
      a=T38FaxUdpEC:t38UDPFEC
      a=T38FaxMaxBufferSize:2000
      a=T38MaxDatagram:512
      a=T38MaxBitRate:14400
      (… additional T.38 attributes may be included)
     }
    }
   },
   Events = 1235 {
    ipfax/faxconnchange ; registration for end-of-fax
                        ; event
   }
}
</pre></td><td></td></tr>
<tr><td><pre>
6) Modification Reply (MG to MGC):
MEGACO/2 [11.9.19.70]
…
Modify = ip/8/3/2 { ; IP "T.38" Termination
  Media {
   Stream = 1 { ; there is just one Stream per Term.
    Local{
     v=0 ; Media Group "packet relay flow for fax"
     c=IN IP4 12.9.4.6
     m=image 58130 udptl t38
     a=T38FaxVersion:1
     a=T38FaxRateManagement:transferredTCF
     a=T38FaxUdpEC:t38UDPFEC
     a=T38FaxMaxBufferSize:2000
     a=T38MaxDatagram:512
     a=T38MaxBitRate:14400
     (… additional T.38 attributes may be included)
    },
    Remote{
     v=0 ; Media Group "packet relay flow for fax"
     c=IN IP4 12.9.19.65
     ..
     m=image 102 udptl t38
     a=T38FaxVersion:1
     a=T38FaxRateManagement:transferredTCF
     a=T38FaxUdpEC:t38UDPFEC
     a=T38FaxMaxBufferSize:2000
     a=T38MaxDatagram:512
     a=T38MaxBitRate:14400
     (… additional T.38 attributes may be included)
    }
}}}
</pre></td><td>Again, a positive acknowledgement by the MG</td></tr>
</table>

Step 4 (Table II.4): request/reply cycle, initiated now by the MG due to a detected event concerning successful end of fax transmission. This event notification will be the trigger for the MGC for starting step 5 in order to switch back to audio.

Table II.4 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 4

ITU-T H.248 encoding (shortened command)	Comment

7) Notification Request (MG to MGC):
MEGACO/2 [11.9.19.70]
…
Notify = ip/8/3/2 {
ObservedEvents = 1235 {
ipfax/faxconnchange{faxconnchng=EOF}
}
}
	"T.38" IP termination reports detection of end-of-fax event.

8) Notification Reply (MGC to MG): MEGACO/2 [11.9.19.65] … Notify = ip/8/3/2	

Step 5 (Table II.5): request/reply cycle for restoring the audio information again on the ITU-T T.38 side.

Table II.5 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 5

ITU-T H.248 encoding (shortened command)	Comment

9) Modification Request (MGC to MG):
MEGACO/2 [11.9.19.65]
…
Modify = ip/2/2/1 { ; ***IP "V.152" Termination***
Events = 1234 {ctyp/dtone} ; MGC requests H.248.2
; ctyp/dtone event
; notification
},
Modify = ip/8/3/2 { ; ***IP "T.38" Termination***
Media {
Stream = 1 { ; there is just one Stream per Term.
LocalControl{
ipdc/realm = "providerY.com"
; IP network indication (here "T.38 domain")
Mode=SendReceive,
ReservedGroup = OFF,; one media group
ReservedValue = OFF ; just one audio codec, might
; also be ON in case two or
; audio codecs are requested
; in 'audio' media descr.
},
Local{
v=0 ; **Single Media Group** "audio flow"
c=IN IP4 12.9.4.6
…
m=**audio** 40120 **RTP/AVP** 8 127
a=rtpmap:127 telephone-event/8000
a=ptime:20
},
Remote{
v=0 ; **Single Media Group** "audio flow"
c=IN IP4 12.9.19.65
…
m=**audio** 100 **RTP/AVP** 8 127
a=rtpmap:127 telephone-event/8000
a=ptime:20
}
}}}
	IP* "V.152" *termination:
	The MGC subscribes for the ITU-T H.248.2 *ctyp/dtone* event on the "V.152" IP termination to be notified in case (fax) modem specific events are detected.
	
	IP* "T.38" *termination:
	MGC restores the audio codec based LD and RD. There is no need to modify the faxstate property as the MG sets this implicitly whenever the fax state changes.

Table II.5 – Example ITU-T H.248 stream descriptors – V.152-to-T.38 context – ITU-T T.38 MGC controlled transitioning method – Step 5

<table>
<tr><th>ITU-T H.248 encoding (shortened command)</th><th>Comment</th></tr>
<tr><td>

```
10) Modify Reply (MG to MGC):
MEGACO/2 [11.9.19.70]
…
Modify = ip/2/2/1,
Modify = ip/8/3/2 { ; IP "T.38" Termination
  Media {
   Stream = 1 { ; there is just one Stream per Term.
    Local{
     v=0  ; Single Media Group "audio flow"
     c=IN IP4 12.9.4.6
     …
     m=audio 40120 RTP/AVP 8 127
     a=rtpmap:127 telephone-event/8000
     a=ptime:20
    },
    Remote{
     v=0  ; Single Media Group "audio flow"
     c=IN IP4 12.9.19.65
     …
     m=audio 100 RTP/AVP 8 127
     a=rtpmap:127 telephone-event/8000
     a=ptime:20
    }
}}}
```

</td><td></td></tr>
</table>

The two selected media formats for audio are identical at both terminations; there is thus not any audio transcoding enforced (when in audio state).

It may be noted that the major portion of ITU-T H.248 signalling traffic is related to the ITU-T T.38 side, whereas the ITU-T V.152 termination is fairly simple and straightforward from a gateway control perspective.

II.4.2.2 V.152-to-T.38 context and ITU-T T.38 autonomous transitioning method

[ITU-T T.38] also defines an MG autonomous transition method for ITU-T H.248 controlled ITU-T T.38 bearer endpoints.

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