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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Communication
procedures

Gateway control protocol: IP router packages

Recommendation ITU-T H.248.64



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Recommendation ITU-T H.248.64

Gateway control protocol: IP router packages

Summary

Recommendation ITU-T H.248.64 has in scope ITU-T H.248 media gateways with connection models using only IP-based ITU-T H.248 streams/terminations. The different modes of IP packet forwarding (in the ITU-T H.248 bearer path) are described. This Recommendation further defines an ITU-T H.248 package for discriminating such modes and protocol elements for the so-called IP router forwarding method. Further ITU-T H.248 packages provide capabilities for service enhanced packet forwarding with respect to the support of additional network address translation.

This revision clarifies the delivery process of an incoming packet to the ITU-T H.248 Context/Termination/Stream to retain consistency with Recommendation ITU-T H.248.79.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.248.64	2009-12-14	16
2.0	ITU-T H.248.64	2013-03-16	16

FOREWORD

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As of the date of approval of this Recommendation, ITU had 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/>.

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Recommendation ITU-T H.248.64

Gateway control protocol: IP router packages

1 Scope

An ITU-T H.248 media gateway (MG) may provide ITU-T H.248 IP-to-IP contexts, which implies an *IP forwarding function* (in the ITU-T H.248 bearer path or IP data path). There are many different forwarding functions possible, dependent on the set of packet processing functions executed, and dependent on whether the MG behaves as a *host* or a *hop* system. Two basic forwarding functions may be identified:

- Back-to-back IP host (B2BIH) mode.
- IP router (IPR) mode.

The B2BIH mode is inherently supported by the ITU-T H.248.1 protocol architecture; the IPR mode is addressed within this Recommendation. In the IPR mode, if IP packets are routed between a private network and a public network, network address translation (NAT) functionality is also supported by this Recommendation.

1.1 Applicability

1.1.1 Applicability of the B2BIH mode

This mode is applied in the case that an ITU-T H.248 context provides either:

- a single IP host entity (like a physical-to-IP context for residential, access or trunking media gateways); or
- back-to-back host configurations as, e.g., required for *service interworking* [ITU-T Y.1251] above the IP layer (between two IP domains) or L3 address translations, i.e., whenever the IP stack must be entirely terminated.

1.1.2 Applicability of the IPR mode

This mode provides the basic IP router functions and may be also applied with additional routing/forwarding behaviours, e.g.:

- forwarding of session-individual IP bearer traffic;
- forwarding of IP-based signalling traffic;
- forwarding of aggregated IP traffic;
- forwarding with specific NAT behaviour;
- MG-embedded IP edge router (IPER);
- MG-embedded DiffServ IP edge router (DER);
- MG-embedded MPLS label edge router (LER);
- congestion control for IP traffic.

This Recommendation supports IP unicast forwarding. Multicast forwarding (see clause 5.2.1.3 of [IETF RFC 1812]) is basically covered by the design of the ITU-T H.248.64 packages, but details are left for future study.

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.248.1] Recommendation ITU-T H.248.1 (2013), *Gateway control protocol: Version 3*.
- [ITU-T H.248.43] Recommendation ITU-T H.248.43 (2008), *Gateway control protocol: Packages for gate management and gate control*.
- [ITU-T H.248.79] Recommendation ITU-T H.248.79 (2012), *Gateway control protocol: Guidelines for packet-based streams*.
- [ITU-T Y.1251] Recommendation ITU-T Y.1251 (2002), *General architectural model for interworking*.
- [IETF RFC 1122] IETF RFC 1122 (1989), *Requirements for Internet Hosts – Communication Layers*.
- [IETF RFC 1812] IETF RFC 1812 (1995), *Requirements for IP Version 4 Routers*.
- [IETF RFC 2663] IETF RFC 2663 (1999), *IP Network Address Translator (NAT) Terminology and Considerations*.
- [IETF RFC 3022] IETF RFC 3022 (2001), *Traditional IP Network Address Translator (Traditional NAT)*.
- [IETF RFC 4292] IETF RFC 4292 (2006), *IP Forwarding Table MIB*.
- [IETF RFC 4787] IETF RFC 4787 (2007), *Network Address Translation (NAT) Behavioral Requirements for Unicast UDP*.

3 Terms and Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 external (address/network), clause 3.1.3 in [ITU-T H.248.43]: A global or public network is an address realm with unique network addresses assigned by Internet Assigned Numbers Authority (IANA) or an equivalent address registry. This network is also referred to as an external network during NAT discussions.

3.1.2 internal (address/network), clause 3.1.2 in [ITU-T H.248.43]: A private network is an address realm independent of external network addresses. A private network may also be referred to as a local network. Transparent routing between hosts in private realm and external realm is facilitated by a NAT router.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 back-to-back IP host (B2BIH) mode: A context of two or more IP-based terminations, where each termination appears to the rest of the network as an IP host (in contrast to an IP router).

3.2.2 IP forwarding: An IP packet forwarding process following the requirements set given by clause 5.2 of [IETF RFC 1812].

NOTE – IETF RFC 1812-conformant forwarding is also called "classical IP forwarding" function.

3.2.3 interface IP router (IIPR) termination: An IP-based ITU-T H.248 physical (Note 1) termination, belonging to an ITU-T H.248 context of type "IIPR". An IIPR termination is consistent with clause 6.2 of [ITU-T H.248.1], i.e., "sources and/or sinks media". An IIPR termination is tightly coupled to a local layer 2 logical interface in a 1:1 relationship. That layer 2 logical interface (inclusive of the assigned IP interfaces) may thus not be shared (Note 2) by other IIPR or B2B IP terminations (Note 3).

NOTE 1 – The rationale behind this is the persistence of an IP interface associated with an IP router entity. It may be noted that an "ITU-T H.248 physical IP termination" may still represent either a physical or a logical IP interface.

NOTE 2 – The rationale behind this is the underlying lookup process for (IP) packet-to-"IIPR context/termination" assignment. The lookup-key is derived from the forwarding information base (FIB), which relates to the tuple of {NetworkID, Mask} in case of native/classical IP forwarding. The element 'NetworkID' represents L3 destination address (DA) information only (which is tightly coupled to the L2 logical interface, due to local L3-to-L2 address bindings) thus, no L4 (or other PCI) is used for packet classification.

NOTE 3 – Whether the MG resource of a logical layer 2 interface may be shared or not is dependent on the applied lookup-key (e.g., a 1-tuple lookup-key, using the identifier of the logical layer 2 interface as single element, does not allow sharing of that interface).

3.2.4 IP router (IPR) mode: A dual-homing configuration (for unicast traffic) in next hop mode. The native IPR mode relates to a classical IP forwarding function, i.e., a media-agnostic and transport-protocol-agnostic per-hop behaviour (PHB) of IP packets.

3.2.5 route IP router (RIPR) termination: A virtual ITU-T H.248 ephemeral termination, belonging to an ITU-T H.248 context of type "RIPR". An RIPR termination is based on clause 6.2 of [ITU-T H.248.1], but without the capability to "source and/or sink media". This limits the number of characterizing properties for this termination type. An RIPR termination defines information of a partial or entire forwarding information base (FIB) entry. The addition of further RIPR terminations to the context is for further study.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ABNF	Augmented Backus-Naur Form
AS	Autonomous System
B2B	Back-to-Back
B2BIH	Back-to-Back Internet protocol Host (mode), also briefly "B2B"
BGP	Border Gateway Protocol (an IP routing protocol)
DA	Destination Address (IP)
DER	DiffServ IP Edge Router
DiffServ	Differentiated Services (IETF QoS concept)
ER	Edge Router (IP)
FIB	Forwarding Information Base
H	Host (IP)
IIPR	Interface Internet Protocol Router
IP	Internet Protocol

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IPER	Internet Protocol Edge Router
IPR	Internet Protocol Router (mode)
LD	Local Descriptor/Local Destination (IP connection endpoint)
LER	(MPLS) Label Edge Router
LS	Local Source (IP connection endpoint)
Lx	(protocol) Layer x (x = 1, 2 or 3)
LxVPN	(protocol) Layer x Virtual Private Network (x = 2 or 3)
MAC	Media Access Control
MD	Media Descriptor
MG	Media Gateway
MGC	Media Gateway Controller
MIB	Management Information Base
MPLS	Multiprotocol Label Switching
NAT	Network Address Translation
NIPR	Network address translation Internet Protocol Router
OSPF	Open Shortest Path First (an IP routing protocol)
PCI	Protocol Control Information
PHB	Per-Hop Behaviour
QoS	Quality of Service
R	Router (IP)
RD	Remote Descriptor/Remote Destination (IP connection endpoint)
RIB	Routing Information Base
RIP	Routing Information Protocol (an IP routing protocol)
RIPR	Route Internet Protocol Router
RS	Remote Source (IP connection endpoint)
RTCP	Real-time Transport control protocol
SA	Source Address (IP)
SCTP	Signalling Control Transmission Protocol
SDP	Session Description Protocol
SNMP	Simple Network Management Protocol
VLAN	Virtual Local Area Network
VPN	Virtual Private Network
TTL	Time-To-Live (IP)

5 Conventions

This Recommendation refers to the generic and IP connection relevant "connection endpoint naming conventions" according to clause 5.2 of [ITU-T H.248.1].

@ is used to denote an (IP network) address.

6 Overview – IP packet forwarding in ITU-T H.248 media gateways

6.1 Unidirectional model

An ITU-T H.248 MG may provide one or multiple IP interfaces (logical or physical IP interfaces) for bearer traffic. The MG is then a single-homed or multi-homed IP node type. MGs with at least one physical IP interface and at least two logical IP interfaces per MG are considered, i.e., at least a dual-homed IP MG.

Any incoming IP packet is forwarded to an outgoing IP interface. This unidirectional view is the basic model for IP flows. Figure 1 illustrates such a model for an ITU-T H.248 MG. The bearer traffic relates to IP flows going through IP-to-IP contexts. The fact that ITU-T H.248 streams are bidirectional communication paths is not relevant for the model here.

There are k ingress and m egress IP interfaces in the unidirectional model shown in Figure 1. The assumption that each IP route may be used in a bidirectional manner ($k = m$) is typically valid in practice and shall hold thus also for this Recommendation. The process of IP packet forwarding comprises the transfer function to relay a received packet from interface x_i to egress interface y_j . Two basic modes of operation for IP forwarding may be considered (see the following clauses) from an ITU-T H.248 MG point of view.

The differences between both IP forwarding modes are mainly related to the handling of IP header address information and the determination of the egress IP interface.

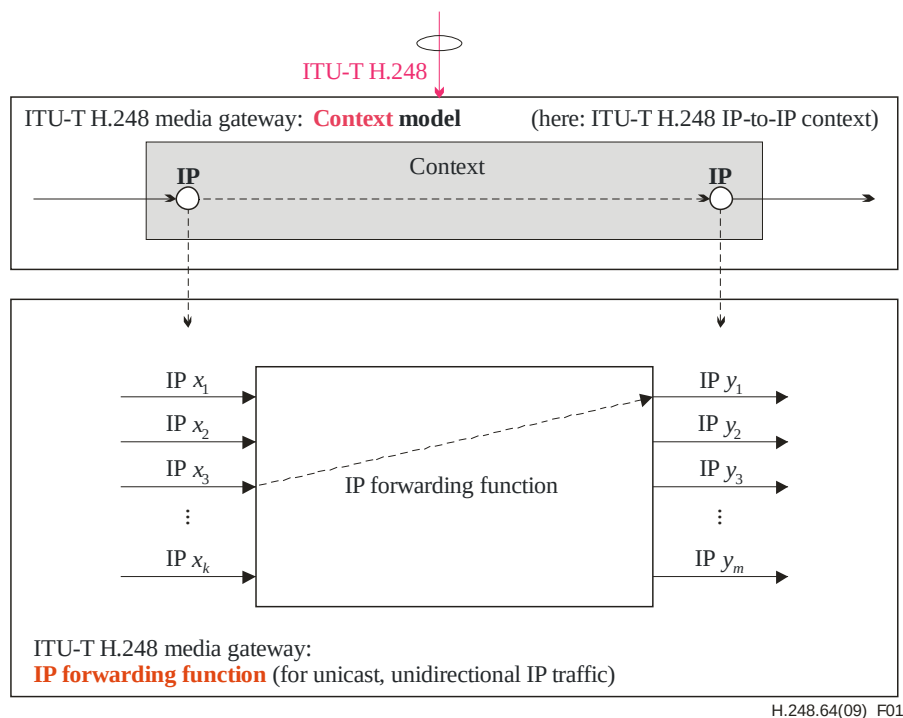


Figure 1 – IP packet forwarding in multi-homed IP ITU-T H.248 media gateways

6.2 Model for back-to-back IP host (B2BIH) mode

Figure 2 illustrates the model for the back-to-back IP host (B2BIH) mode. Any IP packet received at interface x_i has the DA x_i ; the interface represents the *destination host* (see [IETF RFC 1812]) for such a packet. Network address DA x_i relates to the ITU-T H.248 *local destination address* LD(A) (of the IP connection *endpoint*, represented by termination Ta). The IP packet is forwarded and sent at interface y_j with SA y_j ; the interface represents thus the *source host*. Network address SA y_j

relates to the ITU-T H.248 *local source* address LS(A) (of termination Tb). ITU-T H.248 IP terminations Ta and Tb relate therefore to the *destination host* and *source host* respectively, in the B2BIH *host* model.

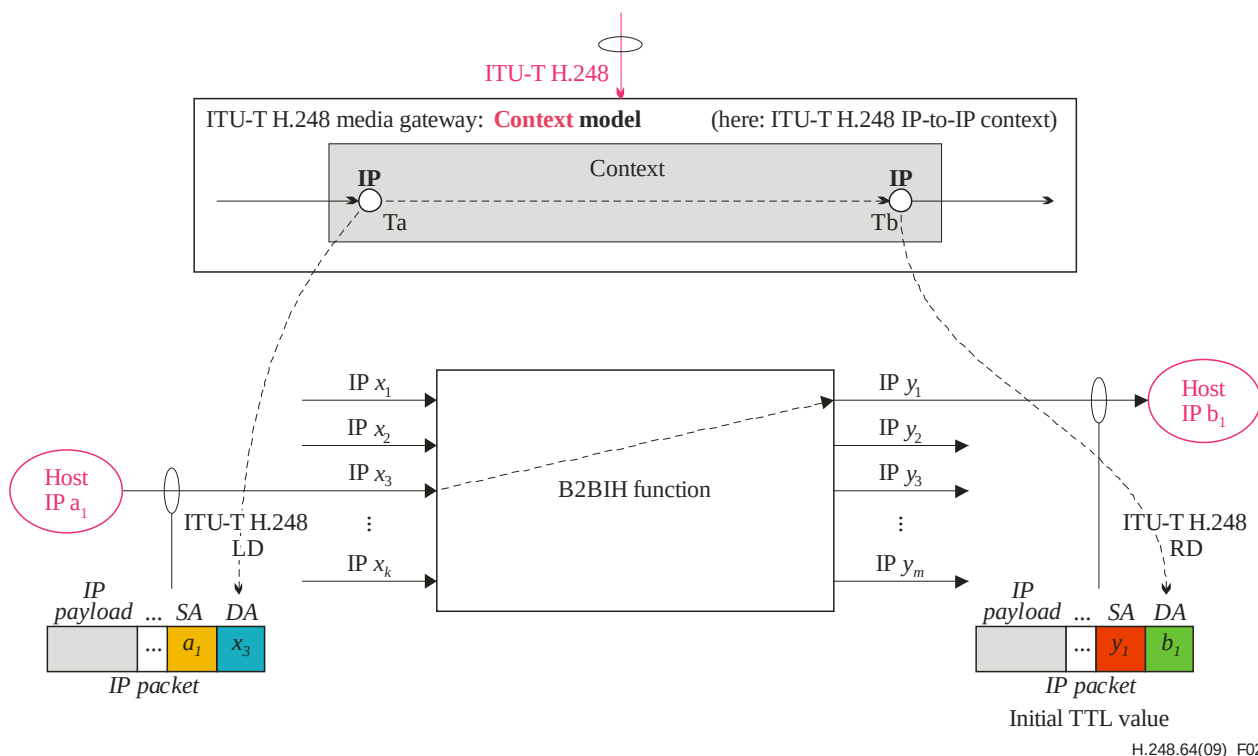


Figure 2 – Model for back-to-back IP host (B2BIH) mode

The major characteristics of the B2BIH mode are:

- 1) IP header processing:
 - a) Address fields: *inherent* network address translation (NAT) function.
 NOTE 1 – If a NAT-less mode is explicitly enforced, see, e.g., [b-ETSI TS 183 018].
 - IP SA field: Ta: *remote source* address RS(A = a_1) → translated to Tb: *local source* address LS(A = y_1).
 - IP DA field: Ta: *local destination* address LD(A = x_3) → translated to Tb: *remote destination* address RD(A = b_1).
 - b) Other header fields: according to regular *host* packet processing (see [IETF RFC 1122]), e.g., initial TTL value setting for outgoing packets.
 NOTE 2 – Native host behaviour may be overruled, e.g., due to security goals in hiding network topology.
- 2) Determination of next hop: given by ITU-T H.248 *context topology*.
 - IP interfaces y_1 and x_3 are associated with the ITU-T H.248 context.
 - In general, *unicast* forwarding is related to a *two* termination context. Such a connection model may be also used for *multicasting*, however multicasting may also be achieved with more than two terminations and corresponding topology settings.
 - FIB: very small table (dependent on number of terminations per context and number of streams per termination); e.g., one row entry in the simplest case.

The B2BIH mode divides an end-to-end (or peer-to-peer) IP connection into two bearer legs.

6.3 Model for native IP router (IPR) mode

The classical IP forwarding function is defined by [IETF RFC 1812], see Figure 3. The major difference to the B2BIH mode is in IP address processing. The MG (or context) acts as *next hop*, which means that neither the SA nor the DA information is modified by the hop.

This means that there is no *direct* relation (as in the B2BIH mode) between network addresses b_1 (DA) and x_3 (interface) from the *hop* perspective.

NOTE 1 – The relation between b_1 and x_3 is a *network level* aspect (due to IP routing). The *previous hop* determined an IP route with *next hop* address x_3 for IP destination address b_1 . This IP route is not dedicated only for destination b_1 in general, it is rather for many different destination addresses or address ranges (subnets), dependent on the network topology (and the current visible routing topology is stored in the local routing information base (RIB)). That means that interface x_3 may theoretically receive IP packets with *any* DA value.

The ITU-T H.248 *local destination* address x_3 (represented by termination Ta) is thus not tightly coupled with *remote destination* address b_1 .

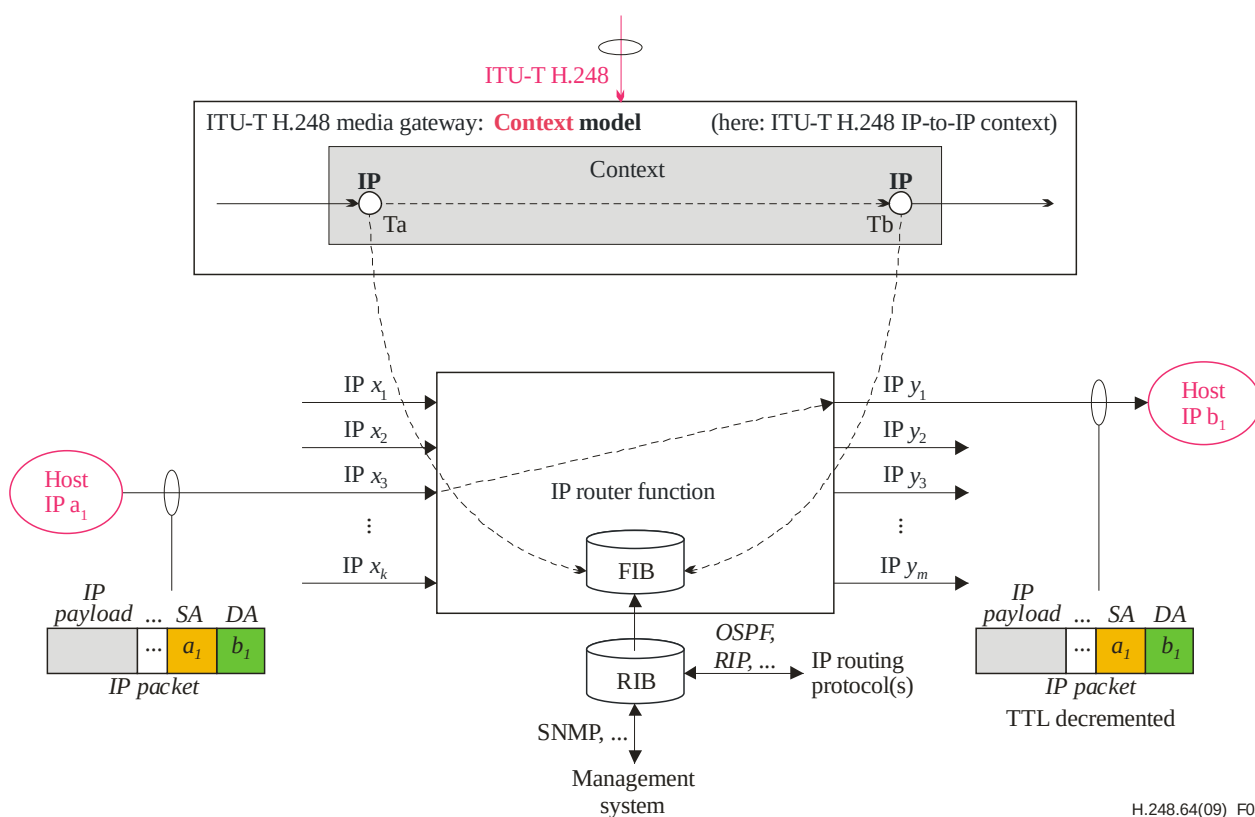


Figure 3 – Model for native IP router (IPR) mode

There is a similar situation for the egress direction and the relation between ITU-T H.248 local source address y_1 (represented by termination Tb) and remote source address a_1 .

The packet forwarding between Ta and Tb (within the context) is controlled via the context-associated FIB. Many FIB structures are possible, e.g., in the case of "destination address"-only based routing would lead DA b_1 to a next hop determination behind interface y_1 . The definition of a specific FIB structure is thus outside of the scope of this Recommendation.

Figure 3 indicates the local FIB, which may provide a self-contained provisioning access interface, or an interface to the MG local RIB, which again may provide an SNMP-based provisioning interface (for static route configuration, see clause 7.4 of [IETF RFC 1812]) and/or routing protocol interfaces.

NOTE 2 – SNMP is mandatory for IP routers (see clause 8.1 of [IETF RFC 1812]).

Major characteristics of the native IPR mode:

- 1) IP header processing:
 - a) Address fields: no NAT per default. This may be achieved, e.g., by "local and remote descriptor"-less ITU-T H.248 IP terminations, or even "media descriptor"-less ITU-T H.248 IP terminations. The descriptors would be then omitted in the ADD.request command for the IP termination (see, e.g., clause 9.6.1.2).
 - b) Other header fields: according to regular next hop packet processing (see [IETF RFC 1812]), e.g., TTL value decrease for outgoing packets.
- 2) Determination of next hop (i.e., interface IP_{yi}): given by a FIB, the FIB may be associated to an ITU-T H.248 context. The FIB table size depends primarily on the set of remote destination addresses b_i (per ingress termination T_a).

This forwarding mode describes very basic per-hop behaviour (PHB). Such a PHB may be augmented by many different IP services. Such services are outside of the scope of this Recommendation.

6.4 MG-embedded router versus router-embedded MG

The "IP router function" may be realized in a stand-alone manner or be embedded in another system (see clause 2.2.8.1 of [IETF RFC 1812]). Figure 3 illustrates an MG-embedded IP router function. On the other hand, it may be noted that an ITU-T H.248 MG function may also be embedded in a stand-alone IP router as a "router-embedded MG function".

6.5 IPR mode

6.5.1 Basic concepts

The IPR mode context model consists of three concepts:

- 1) **The interface IPR (IIPR) context:** This context describes the connections between the different IP interfaces (and underlying local L2 interfaces) originated/terminated on an MG. This is as per a normal ITU-T H.248 connection model where all terminations connected to a context are "bothway" connected to each other (unless modified by topology). Thus, a packet arriving at an interface/termination has the possibility to leave on any other termination in the context. No routing information is described in the context itself, the routing table is described elsewhere. This context would allow interface-based traffic monitoring, filtering and statistics gathering. This usage of terminations/contextes aligns with clause 6.2 of [ITU-T H.248.1] to describe a multiplexed bearer.
- 2) **The route IPR (RIPR) context:** This context describes a single route entry in the routing table. In this way, when a routing context is created, an entry is added to the table. There are one or more terminations in the route IPR context. When those terminations are subtracted, then the route entry is deleted. It would also allow existing ITU-T H.248 statistics, properties and events to be used to enable route-based traffic management, filtering and statistic gathering. This type of context is labelled a route IPR context and the terminations in it do not contain address information in the local and remote descriptors (basically, it is a "virtual connection").

- 3) **The NAT IPR (NIPR) mapping context:** This context describes a single NAT mapping entry in the NAT mapping table. In this way, when a NAT IPR context is created, an entry is added to the table. There are two terminations in the NAT IPR context. When those terminations are subtracted, then the NAT mapping entry is deleted. It also allows the use of existing ITU-T H.248 statistics, properties and events to enable NAT-based traffic management, filtering and statistic gathering. This type of context is labelled a NAT context. As per the route IPR context, the terminations in the NAT IPR context do not contain address information in the local and remote descriptors.

To tie the concepts together, a correlation identifier is needed in order to tie a particular route IPR context and optionally a NAT IPR context with an interface IPR context. In this way, the MGC can describe distinct routing and NAT tables based on sets of interfaces. An interface IPR context then uses this correlation identifier to build a routing table. The NAT mapping information provides a link to the interface IPR context.

6.5.2 Information for routing and/or address translation

The terminations in the interface context may also terminate/originate dynamic routing protocols such as routing information protocol (RIP), open shortest path first protocol (OSPF) and border gateway protocol (BGP). Any need for modification of routing table data could then be notified to the MGC, which can then modify the routing contexts; this, in turn, would trigger an update to the routing table data.

Likewise, a need for modification of the MG NAT mapping table data could then be notified to the MGC, which can then modify the NAT IPR contexts; this, in turn, would trigger an update to the NAT mapping table data.

As an interface may have a large number of routes/NAT entries associated with it, further event parameters may be utilized to provide a means for controlling the signalling load to the MGC.

6.5.3 Context models for (MG-embedded) IP router functions

Figures 4 and 5 illustrate the models. Figure 4 illustrates the relationship between the different contexts and functions to provide routing of an IP packet. NAT functionality may also be supported when necessary, see Figure 5.