



**NORTEL**

Nortel Media Gateway 7480/15000

# Technology Fundamentals

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# New in this release

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The following sections detail what is new in *Nortel Media Gateway 7480/15000 Technology Fundamentals* (NN10600-780) for PCR 7.2.

- [Features \(page 10\)](#)
- [Other changes \(page 12\)](#)

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**Attention:** ASPEN, the Gateway Control protocol, (also known as VGCP) is no longer supported on MG 7000/15000 and has been replaced with the standards based ITU-T, H.248 signaling protocol starting in release PCR7.1/SN09. You must upgrade to standards based H.248 prior to the introduction of the release. Refer to NN10261-450.04.02 “Upgrading the Carrier VoIP Network (volume 5)” for the conversion procedures from ASPEN to H.248 and NN10600-272 “Nortel Multiservice Switch 7400/15000 Upgrading Software guide” and NN10419-461 “Upgrading MSS 15000/MG 15000 in Carrier VoIP IP Solutions” for details about HSM.

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## Features

See the following sections for information about feature changes:

- [Channel Associated Signalling \(page 11\)](#)
- [Media Gateway V5.2 signalling on VSP3-o \(page 11\)](#)
- [Media Gateway as a Host device \(page 11\)](#)
- [Media Gateway Transcoder Free and Remote Transcoder operation modes \(page 11\)](#)
- [Media Gateway alternative call waiting and additional support for international tonesets \(page 11\)](#)
- [Media Gateway Customer accessible PING \(page 11\)](#)
- [Media Gateway Additional Codecs for IP and ATM \(page 12\)](#)
- [Media Gateway New codec handling method \(page 12\)](#)
- [Media Gateway New 2pVSP4e card \(page 12\)](#)
- [Media Gateway New 2pVS card \(page 12\)](#)

- [Public Key Infrastructure \(page 12\)](#)

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**Attention:** Some Multiservice Switch (MSS) features and configurations may not be supported on Media Gateway7480/15000. Please contact your Nortel account representative to determine whether a specific base Multiservice Switch feature is supported on your Media Gateway7480/15000 platform.

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### **Channel Associated Signalling**

The following sections were updated for this feature:

- [Channel Associated Signaling \(CAS\) congestion control \(page 150\)](#)
- [Switched MG faults \(page 167\)](#)
- [Channel Associated Signaling \(CAS\) \(page 94\)](#)

### **Media Gateway V5.2 signalling on VSP3-o**

The following section was updated for this feature:

- [V5.2 for VSP3-o \(page 86\)](#)

### **Media Gateway as a Host device**

The following section was updated for this feature:

- [Media Gateway as a Host \(page 106\)](#)

### **Media Gateway Transcoder Free and Remote Transcoder operation modes**

The following sections were updated for this feature:

- [Transcoder Operation modes \(page 23\)](#)
- [EVRC0 voice call compression \(page 58\)](#)

### **Media Gateway alternative call waiting and additional support for international tonesets**

The following sections were updated for this feature:

- [Audible tones for switched MG \(page 73\)](#)
- [Definitions of audible tones by country \(page 183\)](#)

### **Media Gateway Customer accessible PING**

The following sections were updated for this feature:

- [Customer accessible PING \(page 156\)](#)
- [Diagnosing ping failure from the ControlConnection component \(page 160\)](#)

### **Media Gateway Additional Codecs for IP and ATM**

The following sections were updated for this feature:

- [Voice compression for switched MG using ATM \(page 43\)](#)
- [G.711A and G.711U voice call compression \(page 44\)](#)
- [G.726ITU voice call compression \(page 44\)](#)
- [G.711U and G.711A voice call compression \(page 57\)](#)
- [G.726-32K ITU voice call compression \(page 58\)](#)
- [EVRC0 voice call compression \(page 58\)](#)

### **Media Gateway New codec handling method**

The following sections were updated for this feature:

- [Codecs and the defaultCodecList \(page 69\)](#)
- [Migration behavior in the Codec list \(page 72\)](#)

### **Media Gateway New 2pVSP4e card**

The following sections were updated for this feature:

- [Introduction to Media Gateway 7480/15000 \(page 14\)](#)
- [Switched Media Gateway using IP functionality \(page 50\)](#)
- [Switched Media Gateway using ATM or IP functionality \(page 68\)](#)
- [Installing and setting up Media Gateway \(page 131\)](#)
- [Fault management for Media Gateway \(page 152\)](#)

### **Media Gateway New 2pVS card**

The following sections were updated for this feature:

- [Transcoder Operation modes \(page 23\)](#)
- [Supported Codecs per Feature packaging and Card Type: \(page 70\)](#)
- [Codec list after an upgrade \(page 73\)](#)

### **Public Key Infrastructure**

The following section was updated for this feature:

- [IPSec for switched MG call control connections in Carrier VoIP networks \(page 136\)](#)

## **Other changes**

Other changes made to this document include the following:

- Updated the [Introduction to Media Gateway 7480/15000 \(page 14\)](#) with non-switched and switched Media Gateway architecture.

- Updated [Retry interval for AtmTConn components \(page 129\)](#) to include the distinction between the retry behaviors of Switched (SATCOM) and Non-switched (NSATCOM) components.

## Related documents

This guide makes reference to several documents. Some procedures require you to use one or more documents in conjunction with a given procedure. Other documents are sources of more detailed or related information.

- *Nortel Multiservice Switch 7400 Installation, Maintenance, and Upgrade – Hardware* (NN10600-175)
- *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551)
- *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550)
- *Nortel Multiservice Switch 15000/20000 Installation, Maintenance, and Upgrade – Hardware* (NN10600-130)
- *Nortel Multiservice Switch 7400/15000/20000 ATM Fundamentals* (NN10600-700)
- *DMS-MMP Base Product Description*, Issue M13.3 (approved), 5 May 2000.
- GR-CORE-506, *LSSGR: Signaling for Analog Interfaces*, November 1996
- ITU-T Recommendation E.180, *Technical Characteristics for Tones in the Telephone Service*.
- ITU-T Recommendation E.180, Supplement 2, *Various Tones Used in National Networks*, 1/94.

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# Introduction to Media Gateway 7480/15000

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The Nortel Multiservice Switch (MSS) Media Gateway (MG) acts as a gateway between an ATM or IP network and the TDM devices in service provider networks. The MG allows service providers to carry more voice and voice band data (fax, modem, and data calls) by creating connections between the narrowband devices of the public switched telephone network (PSTN) over broadband ATM or IP domains.

See the following sections for more information on the supported call types:

- [Voice calls \(page 19\)](#)
- [Fax and modem calls \(page 25\)](#)
- [Data calls \(page 27\)](#)

In addition, the MG provides voice services such as:

- transcoding: [Transcoder Operation modes \(page 23\)](#)
- compression: [G.726 fax and modem call compression \(page 26\)](#) and [G.729a fax and modem call compression \(page 26\)](#)
- silence suppression: [Silence suppression \(page 20\)](#)
- echo cancellation: [Echo cancellation \(page 21\)](#)
- packet delay and de-jittering: [Packet delay variation and de-jitter buffer \(page 22\)](#)
- voice encoding: [Considerations for G.729 Annex A and B voice encoding \(page 27\)](#)

The ATM Forum implementation agreement for ATM trunking using AAL2 describes two modes of operation; switched and non-switched. Refer to [Applications \(page 15\)](#) for an overview of the following MSS MG configurations:

- [Non-switched MG configuration \(page 15\)](#)
- [Switched MG configuration \(page 17\)](#)

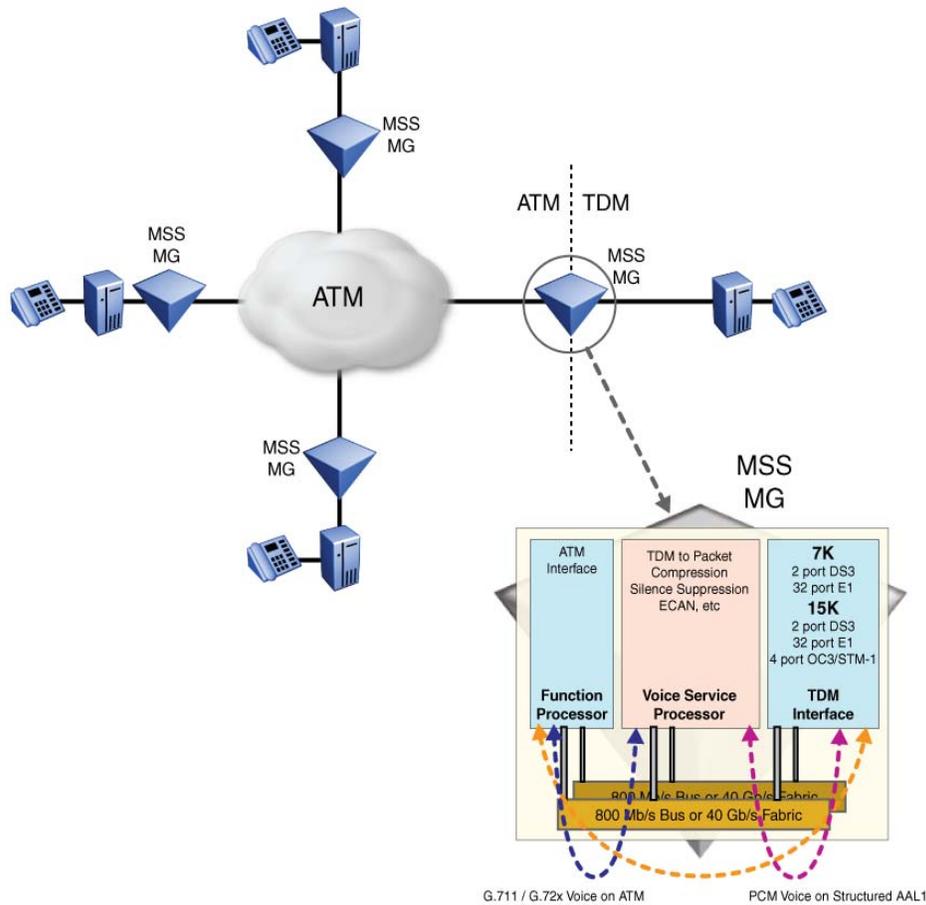
## Applications

The Nortel MG supports both non-switched trunking and proprietary switched trunking. In the non-switched configuration ([Non-switched MG configuration \(page 15\)](#)), the MG provides the ability to statically interconnect TDM domain endpoints across an ATM packet domain. In the switched configuration ([Switched MG configuration \(page 17\)](#)), a Media Gateway Controller (MGC) controls dynamic connections between a packet (IP or ATM) domain and a TDM domain

### Non-switched MG configuration

In the non-switched MG configuration, both static connections and voice services are provisioned based on customer requirements. The non-switched gateway provides the ability for the customer to utilize an ATM packet backbone (see figure [Non-switched MG application \(page 16\)](#)) to interconnect different TDM domains. Using this configuration, both the  $n^2$  (n-squared) TDM interconnected complexity is reduced as well as optional bandwidth savings across the packet network is possible by utilizing the compression ([Voice compression algorithms supported by non-switched Media Gateway using ATM \(page 32\)](#)) and silence suppression ([Silence suppression \(page 20\)](#)) services.

**Non-switched MG application**



Non-switched MG configuration consists of the following processor cards:

- ATM function processor (FP): implements all ATM layer and corresponding physical layer requirements, including ATM Operation and Administration (OAM) functions and ATM emission priorities. Supported ATM FPs are the 4-port OC-3/STM-1 ATM FP and 4-port OC-12/STM-4 ATM FP.
- Voice services processor (VSP): implements all voice services such as tone generation, digit collection, echo cancellation, silence suppression and ingress/egress gain. The VSP also handles packetisation of voice samples. Non-switched MG configuration supports VSP2 only.
- TDM FP: provides the TDM network interface, with physical termination of DS3, E1, or SONET ports combined with the multiplexing/demultiplexing of DS0s from the DS1/DS3/E1/STS. DS0s are mapped (at a DS1/E1 granularity) to an internal connection assigned to the VSP. Supported TDM FPs for the non-switched configuration are the (DS1 under) 2-port DS3 TDM FP, 32-port E1 TDM FP, and the 4-port OC-3/STM-1 Ch TDM/CES FP (configured as a TDM card).

For more information about the non-switched MG functionality, see the following section:

- [Non-switched Media Gateway using ATM functionality \(page 29\)](#)

### **Switched MG configuration**

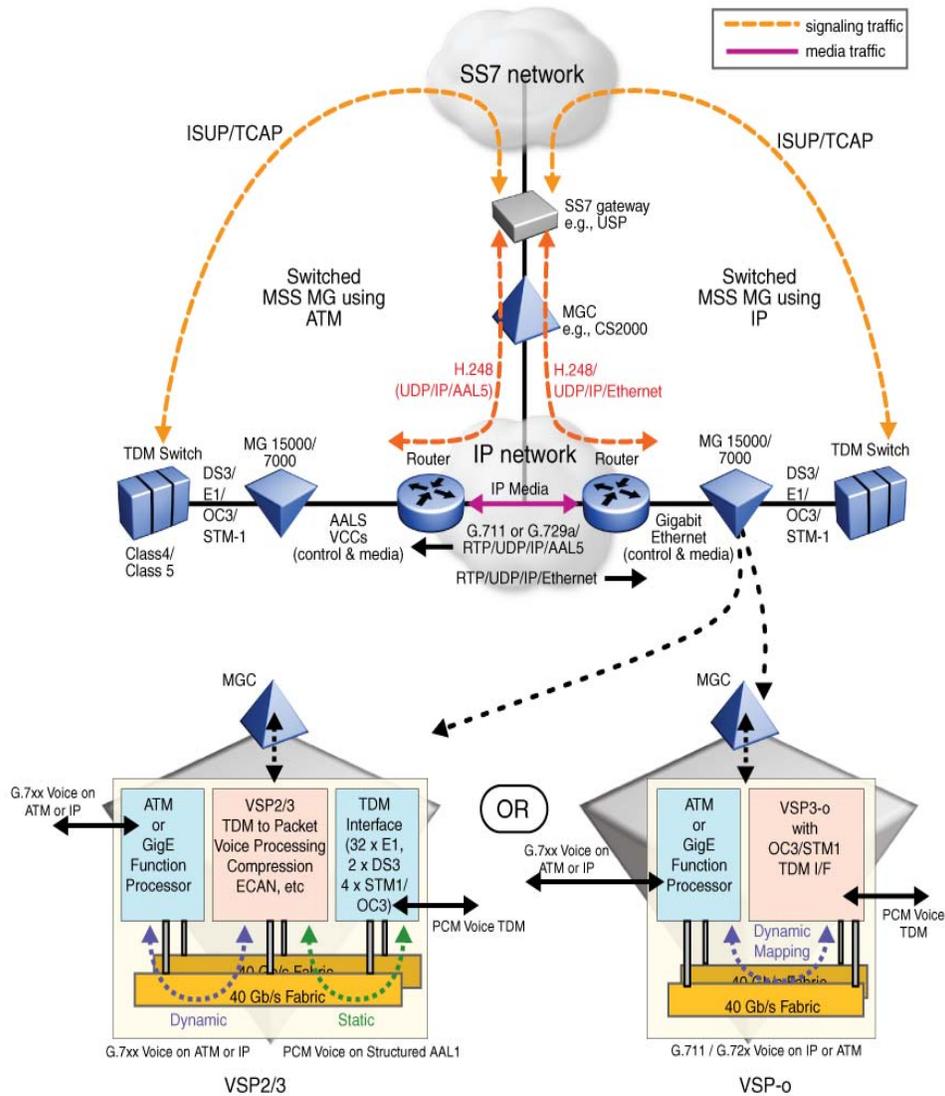
In the switched MG configuration, the MG handles all bearer traffic switching, media (IP and TDM), and voice services, such as data compression, silence suppression, and echo cancellation. Voice and voice band data connections are dynamically created and torn down between the service provider's TDM network and the IP network.

Incoming TDM time slots are dynamically mapped or switched to outgoing UDP ports for each call. This mapping can also occur in the reverse direction, with incoming UDPs being switched to outgoing TDM time slots.

The MGC may be a Carrier VoIP Communication Server 2000 (CS 2000) or Communication Server 2000-Compact (CS 2000-Compact), supporting either H.248 signaling protocols. Each MG can be located across the packet network and can be independently controlled by one or more MGCs. Each VSP (VSP2/VSP3/VSP3-o/2pVSP4e) card housed in a MG 15000/7000 shelf acts as a standalone gateway with its own control connection.

See figure [Switched MSS MG application \(page 18\)](#) for an illustration of switched MSS MG functionality.

**Switched MSS MG application**



In addition to the processor card functionality described in non-switched MG configuration, switched MG configuration incorporates the following functionality:

- ATM FP: implements all IP layer and corresponding physical layer requirements, including IP Operation and Administration (OAM) functions and IP emission priorities. Switched MG configuration over IP supports the 4-port Gigabit Ethernet (4pGigE) FP.
- VSP FP: implements H.248 message handling and IP. The VSP acts upon instructions from the MGC to make/break narrow-band connections

between TDM trunks and RTP flows/AAL2 or IP circuits. Supported VSPs in a switched MG configuration are VSP2, VSP3, VSP3-o, and 2pVSP4e. For configurations using VSP3-o or 2pVSP4e, the TDM function is provided directly on the VSP faceplate, rendering the TDM FP unnecessary.

- TDM FP: A TDM FP is required in VSP, VSP2 and VSP3 configurations only.

For more information about the switched MSS MG functionality, see the following section:

- [Switched Media Gateway using ATM functionality \(page 41\)](#)
- [Switched Media Gateway using IP functionality \(page 50\)](#)
- [Switched Media Gateway using ATM or IP functionality \(page 68\)](#)

## Media Gateway requirements

In addition to the processor cards described in the non-switched and switched MG applications, the following software/hardware devices must be installed on the Nortel Multiservice Switch shelf to configure the MG

- an Ethernet FP card
- an internet protocol (IP) FP card
- Multiservice Switch base software
- Multiservice Switch networking software
- ATM networking (ATM core) software (if required)
- Media Gateway software

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**Attention:** MG supports automatic recognition of TDM T1 or E1 trunk connections and automatically implements Mu-law or A-law companding, based on the trunk type.

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For more information about Multiservice Switch hardware, see *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551). For more information about Multiservice Switch software, see *Nortel Multiservice Switch 7400/15000/20000 Installation – Software* (NN10600-270) and *Nortel Multiservice Switch 7400/15000/20000 Upgrades – Software* (NN10600-272).

## Voice calls

MG provides various services for voice calls, including

- [Silence suppression \(page 20\)](#)
- [Echo cancellation \(page 21\)](#)

- [Packet delay variation and de-jitter buffer \(page 22\)](#)
- [Transcoder Operation modes \(page 23\)](#)
- [Non-switched Media Gateway using ATM services for voice calls \(page 32\)](#)
- [Switched MG using ATM services for voice calls \(page 43\)](#)
- [VoIP services for voice calls \(page 64\)](#)
- [Switched MG using ATM or IP services for voice calls \(page 68\)](#)

### **Silence suppression**

Speech in telephone conversations contains many periods of silence. To save bandwidth, MG suppresses silence and avoids sending voice packets of silence over the link. You can apply silence suppression on all voice calls or only during periods of congestion.

MG suppresses silence on the ingress path after echo cancellation and before speech encoding. Therefore, only speech packets are sent to the far-end device. The far-end device replaces silence with comfort noise. The measured background noise at the near end determines the level of comfort noise at the far end.

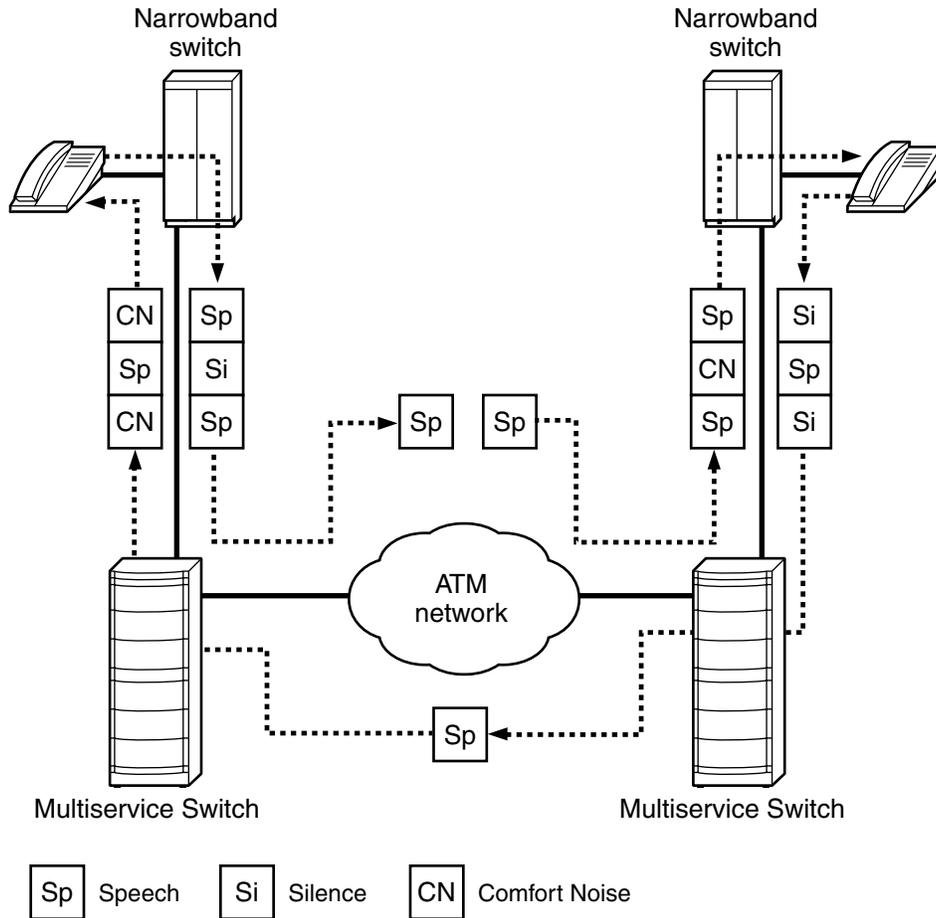
The speech activity detection (SAD) mechanism dynamically tracks the background noise and sets the speech detection threshold relative to this noise. The purpose of this mechanism is to minimize the audibility of silence suppression. The level of comfort noise matches the background noise level to within 1 dB.

The figure [Silence suppression and comfort noise generation \(page 21\)](#) shows the process of replacing silence with comfort noise.

MG uses the following methods to prevent speech clipping:

- MG immediately commences speech transmission upon recognition of the SAD threshold.
- MG inserts a delay (silence detection hang-over time) before halting transmission upon end of speech detection to avoid speech clipping.

### Silence suppression and comfort noise generation



MSS 2942 001 AA

### Echo cancellation

To improve quality, MG uses echo cancellation. The hybrids that convert between 2-wire and 4-wire facilities often introduce the strongest echo. The figure [Echo cancellation and gain control for MG \(page 22\)](#) shows the typical sources of echo.

Nortel Multiservice Switch devices cancel echo at the edges of the network to maintain toll quality voice and to prevent echo from traveling across the network. Echo that travel across the network minimize bandwidth savings from silence suppression.

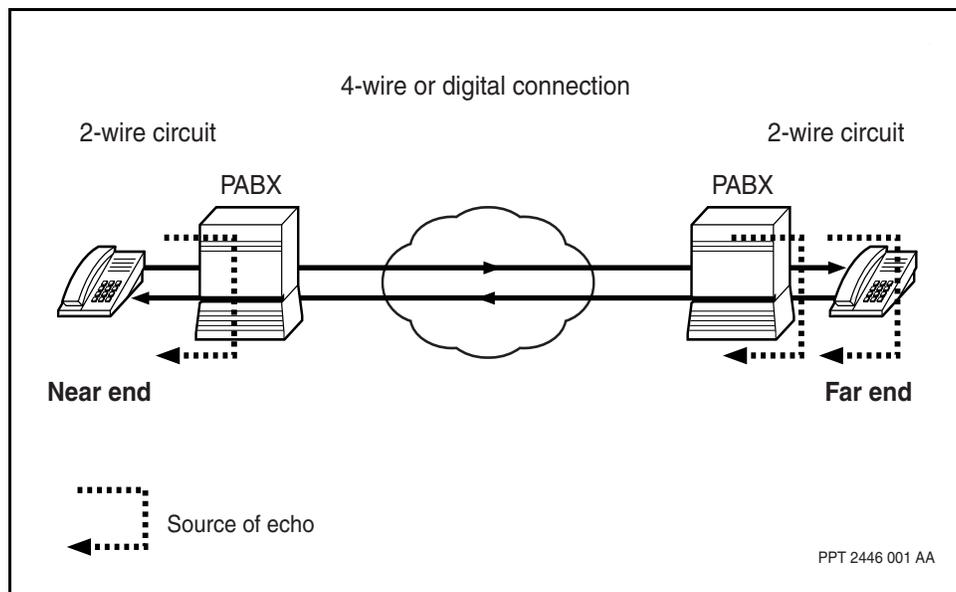
To successfully cancel echo in a system requires a network loss plan. A network loss plan specifies the signal levels throughout a network to which a network conforms. MG provides default settings for echo cancellation (egress and ingress gain control) to satisfy standard North American networks. However, egress and ingress gain control are configurable to support different requirements of international networks.

MG can support two lengths of tail delay for echo cancellation. A 32 ms tail delay is available on the VSP2 for switched MG using ATM or IP. A 128 ms tail delay is available on VSP3voice services processor 3 with optical TDM interface (VSP3-o), and 2pVSP4e for switched VoAAL2 and VoIP applications. Semantic checks prevent the 128 ms option from being selected on VSP2 cards.

MG also enables you to disable echo cancellation for fax and modem calls. For more information, see [Fax and modem calls \(page 25\)](#).

**Attention:** Echo cancellation for switched Media Gateway is controlled by the MGC. In tandem environments, echo cancellation for switched MG may cause some problems due to the simultaneous convergence of echo cancellers placed in series. If the canceller converges on signaling tones, the tones may be distorted. A non-linear distortion of the signal also impacts echo cancellation performance. To prevent this problem, the MG echo canceller turns off if it detects that it is the inner echo canceller in a tandem environment. In addition for echo cancellers in general, a proper gain-loss plan is needed to prevent signal distortion and gain is to be avoided at all times.

#### Echo cancellation and gain control for MG



#### Packet delay variation and de-jitter buffer

Packet generation and multiplexing introduce variable delays between the arrival of packets at a destination and ATM network node re-transmissions. This variable delay is called packet delay variation (PDV). To ensure high

quality voice, MG provides a de-jitter buffer at the egress of the ATM network. This buffer removes the packet jitter without affecting the isochronous nature of the voice traffic.

When voice packets arrive, the de-jitter buffer builds a reserve of packets before it begins to transmit. This reserve of packets and the capacity of the buffer determine the amount of PDV the system can tolerate. The time it takes for the buffer to build up the reserve of packets is called packet delay variation tolerance (PDVT). Typically, the buffer size is twice that of the PDVT value.

If packets arrive too quickly, the buffer overflows, which causes the system to drop packets. If packets experience excessive delay, the buffer underflows. Buffer underflow causes MG to transmit comfort noise. However, if the condition persists for more than the configured length of time, MG activates trunk conditioning. Therefore, you must carefully set the PDVT and buffer size values. To avoid problems, MG provides default settings for these values. Switched MG using IP does not turn on trunk conditioning if buffer underflows persist.

### Transcoder Operation modes

Transcoder Free Operation (TrFO) mode and Remote Transcoder Operation (RTO) mode are two modes of operation used on the MG15000 to carry voice as wireless encoded speech in Enhanced variable rate codec (header free format) (EVRC0) over the packet network.

---

**Attention:** EVRC0 (header free format) is supported in this release. EVRC (with header format interleave/bundle) is not supported in this release.

---

The modes enable the MG15000 to carry voice as wireless encoded speech between mobile users or between a mobile user and the PSTN network. A Nortel proprietary protocol is used to do a handshake between the BSC and the MG to activate TrFO. Then TrFO format is used to carry the encapsulated EVRC0 traffic and support transadaptation. TrFO is supported on the VSP3-o and 2pVSP4ecards only. Remote Transcoder Operation (RTO) functionality is available on VSP3-o, 2pVSP4e, and 2pVS cards.

---

**Attention:** TrFO and RTO modes are not supported simultaneously on the same VSP.

---

TrFO supports 2016 channels on the 2pOc3ChSmIrVsp3 (NTHW77AA) and 4032 channels on the 2pOC3ChSmIrVsp4e (NTHW26). RTO supports 1008 channels on 2pOc3ChSmIrVsp3 (NTHW77AA) and 2016 channels on the 2pVS (NTHW78AA) (MG) and 2pOC3ChSmIrVsp4e (NTHW26) cards. An extra number of DSPs are provisioned on a 2pVS card. The PacketNetworkProfile attribute denotes the network configuration for the MG

as to whether the RTO functionality is disabled or available for wirelineRto, or available for wirelessRto. The PacketNetworkProfile attribute allows the MG to override normal codec negotiation such that it can either optimize bandwidth or reduce the number of transcodings.

### **Transcoding and how a call is transported as EVRC0 traffic**

Transcoding introduces delay and reduces voice quality. The transmission of native wireless voice format across the packet network reduces the need for multiple transcoding operations and results in reduced transmission delays and improved voice quality. This feature reduces the amount of transcoding required in the network for mobile to mobile or mobile to landline calls and allows the MG to realize a gain in bandwidth, see the figure [Transporting a call through a network with TrFO and RTO enabled on the MGs \(page 25\)](#).

In packetized voice core networks, TrFO enables the transmission of native wireless voice between mobiles and allows EVRC0 to be carried across the voice core network in its native format. When TrFO/RTO is possible, calls use the EVRC0 codec for packet voice core network transport. If TrFO/RTO is not possible, calls fall back to G.711U packet voice core network transport. At the far-end of the network, the call is translated into audible speech.

During TrFO operation, the MG may detect reversion of traffic to PCM mode. This is expected when RFC 2833 for DTMF relay is not negotiated over the packet network. If G.711U is supported by the packet network, MG relays the PCM traffic to the packet network in the G.711U RTP format. Otherwise, MG drops the PCM traffic.

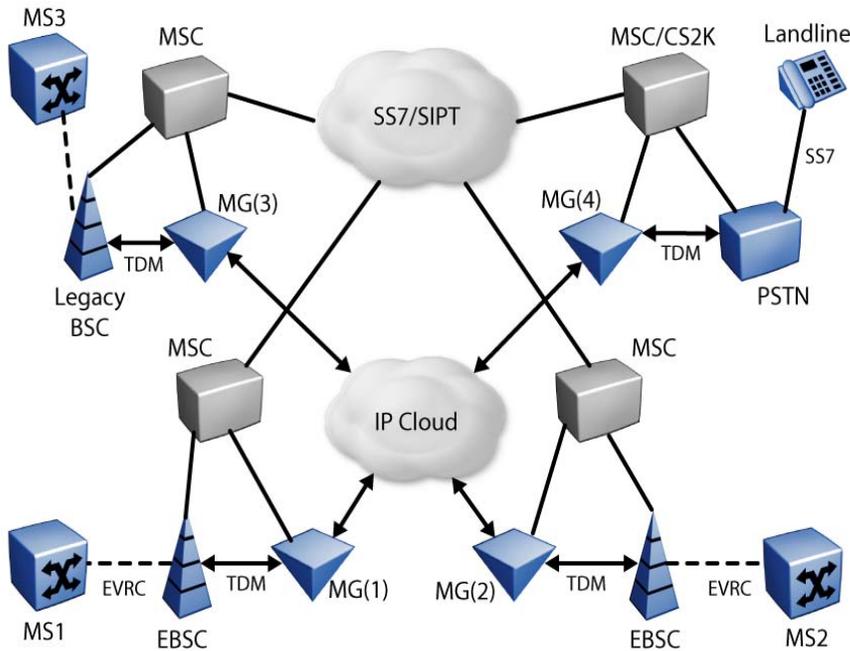
The figure [Transporting a call through a network with TrFO and RTO enabled on the MGs \(page 25\)](#) illustrates the concept of how a call is transported through a network with TrFO and RTO enabled on the MGs. In the figure, MG1 and MG2 use the TrFO mode for the call from MS1 to MS2. In this mode, the TDM connections between the eBSC and the MG (belonging to MSC) can operate using a Nortel TrFO protocol format that carries encapsulated EVRC0 traffic, which enables voice to be carried as EVRC0 over the packet network. When MG is connected to a legacy BSC, as with MG3, MG3 uses the RTO mode of operation for the call from MS1 to MS3 (with MG1 using the TrFO mode). In the same figure, MG4 can use RTO mode for a call from MS1 to a Landline with MG1 using the TrFO mode. The BSC-MG across the TDM connection activates BSC-TrFO support but only after TrFO is successfully established with the remote packet gateway. In cases where the BSC channel is connected in a regular circuit switched call to the PSTN, the channel supports normal circuit switched bearer processing only, without TrFO.

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**Attention:** TrFO and RTO modes are not supported simultaneously on the same VSP.

---

**Transporting a call through a network with TrFO and RTO enabled on the MGs**



In a CDMA wireless network with TrFO mode enabled on the MG, the MG can relay EVRC0 over TDM to EVRC0 over packet. TrFO mode converts between EVRC0 over TDM format (carried between MG and eBSC using a proprietary protocol) and EVRC0 over packet format (carried by the IP network).

In a PSTN TDM network or an SBS with RTO enabled on the MG, the MG can convert the EVRC0 over packet to PCM thereby transcoding the voice payload from the PSTN to EVRC0 format as specified in RFC-3558 for transport over the packet network. That is, if the wireless voice call is connecting to the PSTN, RTO mode is used by the MG to convert between EVRC0 over packet (carried by the IP network) and the voice payload carried by the PSTN network.

**Fax and modem calls**

MG identifies modulated data calls (typically fax and modem calls) by detecting 2100 Hz tones with or without phase reversals. Non-switched MG using ATM functionality detects the 2100 Hz tone from the TDM side only. Switched MG using ATM or IP detects the 2100 Hz tone from the TDM side and the packet side. Calls can be transported at two speeds:

- MG can automatically upspeed from a G.729a speed of 8 kbit/s to a G.711A or G711U speed of 64 kbit/s, or
- the system can compress these calls and transport them at 32 kbit/s using G.726 encoding.

Nortel Networks recommends transporting higher speed fax and modem calls (above 9.6 kbit/s) as uncompressed 64 kbit/s channels. Lower speed fax and modem calls (at or below 9.6 kbit/s) can be transported at either 32 kbit/s or 64 kbit/s.

To further reduce the bandwidth for fax calls in non-switched MG, you can enable fax idle suppression (FIS). FIS can reduce the use of bandwidth by up to 45%. FIS applies to non-switched MG only.

To avoid data corruption, you can configure MG to disable echo cancellation when it detects 2100 Hz tones in accordance with ITU-T Recommendation G.165. If you set the *echoCancellation* attribute to *g165Mode*, the system disables echo cancellation when it detects 2100 Hz tones with 180 phase reversals. For *g165Mode*, echo cancellation is re-enabled when 150 to 350 ms of silence in both directions is detected.

If you set the *echoCancellation* attribute, on the VSP1 or VSP2, to *alwaysOn*, the system does not disable echo cancellation for any calls, regardless of the presence of tones. This setting can cause call connection problems for some modems. The value *alwaysOn* is not applicable on the VSP3, VSP3-o, and 2pVSP4e FP cards.

Non-switched MG and switched MG are compliant with call compression algorithms of G.726 and G.729a for fax or modem calls. See the following sections for more information:

- [G.726 fax and modem call compression \(page 26\)](#)
- [G.729a fax and modem call compression \(page 26\)](#)

### **G.726 fax and modem call compression**

You can configure MG to compress these calls and transport them as 32-kbit/s channels using the G.726 standard. Using the G.726 standard for voice band data (VBD) only applies to ATM adaptation layer 2 (AAL2) traffic.

### **G.729a fax and modem call compression**

You can configure MG to compress calls to 8 kbit/s using G.729a then upspeed to a G.711A or G.711U speed of 64 kbit/s for fax and modem transport.

---

**Attention:** Non-switched MG only supports upspeeding on detection of 2100 Hz and DTMF tones.

---

### **Considerations for G.729 Annex A and B voice encoding**

When MG uses the G.729 Annex A and B encoding with echo cancellation (ECAN), VAD, and dual tone multi-frequency (DTMF) tone detection and upspeed, the capabilities are as follows:

Using the VSP FP in Nortel Multiservice Switch 7400 devices:

- 432 G.729 channels per VSP FP card
- 128 virtual channel connections (VCCs) per VSP FP card

Using the VSP2 FP in Multiservice Switch 7400 devices:

- 720 G.729 channels per VSP2 FP card
- 1024 VCCs per VSP2 FP card

Using the VSP2 FP in Multiservice Switch 15000 and devices:

- 800 G.729 channels per VSP2 FP card
- 1024 VCCs per VSP2 FP card

Using the VSP3 FP for switched MG using IP in Multiservice Switch 15000 device:

- 2016 G.711U / G.726 channels per VSP3 FP card
- 1512 G.711U / G.726 / G.729 channels per VSP3 FP card
- 1024 VCCs per VSP3 FP card

Using the VSP3-o FP, with optical TDM interface, FP for switched MG using ATM or IP in Multiservice Switch 15000 device:

- 2016 G.711A when the packet log law requires A-Law and G.711U when the packet log law requires Mu-Law/ G.729 channels per VSP3-o FP card
- 1500 VCCs maximum per VSP3-o FP card

Using the 2pVSP4e FP for switched MG using IP in Multiservice Switch 15000 devices:

- 4032 G.711A when the packet log law requires A-Law and G.711U when the packet log law requires Mu-Law/ G.729 channels per 2pVSP4e FP card

### **Data calls**

Data calls in MG are carried over CCD connections. Each CCD connection carries a contiguous data stream from the TDM network across the ATM network.

If you configure MG to monitor signaling information, the system can identify the type of traffic on each channel. Note that non-switched MG does not support monitoring of E1 signaling information. To avoid data corruption, MG treats video and data from the TDM network as a contiguous data stream. MG packages the data into AAL2 cells and sends the data to the ATM network as clear 64-kbit/s channels. The clear 64-kbit/s channels run as CCD calls.

MG enables you to configure specific time slots to run as CCD, regardless of the type of signaling used, and regardless of whether the system monitors signaling on other channels.

For non-switched MG, if you use common channel signaling (CCS) on other channels, the time slots that you specify as CCD are transported at 64 kbit/s. If you use channel associated signaling (CAS) at the DS1 level, the time slots that you specify as CCD are transported at 56 kbit/s.

For switched MG using ATM, CCD calls are initiated by the media gateway controller (MGC). The CCD calls provide test trunk capability and end-to-end CCD calls across the ATM network.

CCD calls in switched MG using ATM or IP have the same following requirements:

- no limit on the number of CCD endpoints
- no support for limiting the number of CCD calls per VCC
- supports only narrowband connections of 64-kbit/s for voice or CCD
- no support for more than one 64-kbit/s B channel
- CCD can be carried over both IP and ATM but not on the same VSP2 and not on the same MG shelf

Switched MG using IP CCD calls provide test trunk capability and hairpinning of CCD calls out on the same VSP2, VSP3, VSP3-o, or 2pVSP4e FP. CCD calls in switched MG using IP have the following requirements:

- supported on VSP2, VSP3, VSP3-o, and 2pVSP4e FPs
- not supported on the VSP FP
- not recommended to transport ISDN data over CCD connections
- CCD packets sent using real-time protocol (RTP) with payload type (PT) equal to 101 and a 10 ms packet length

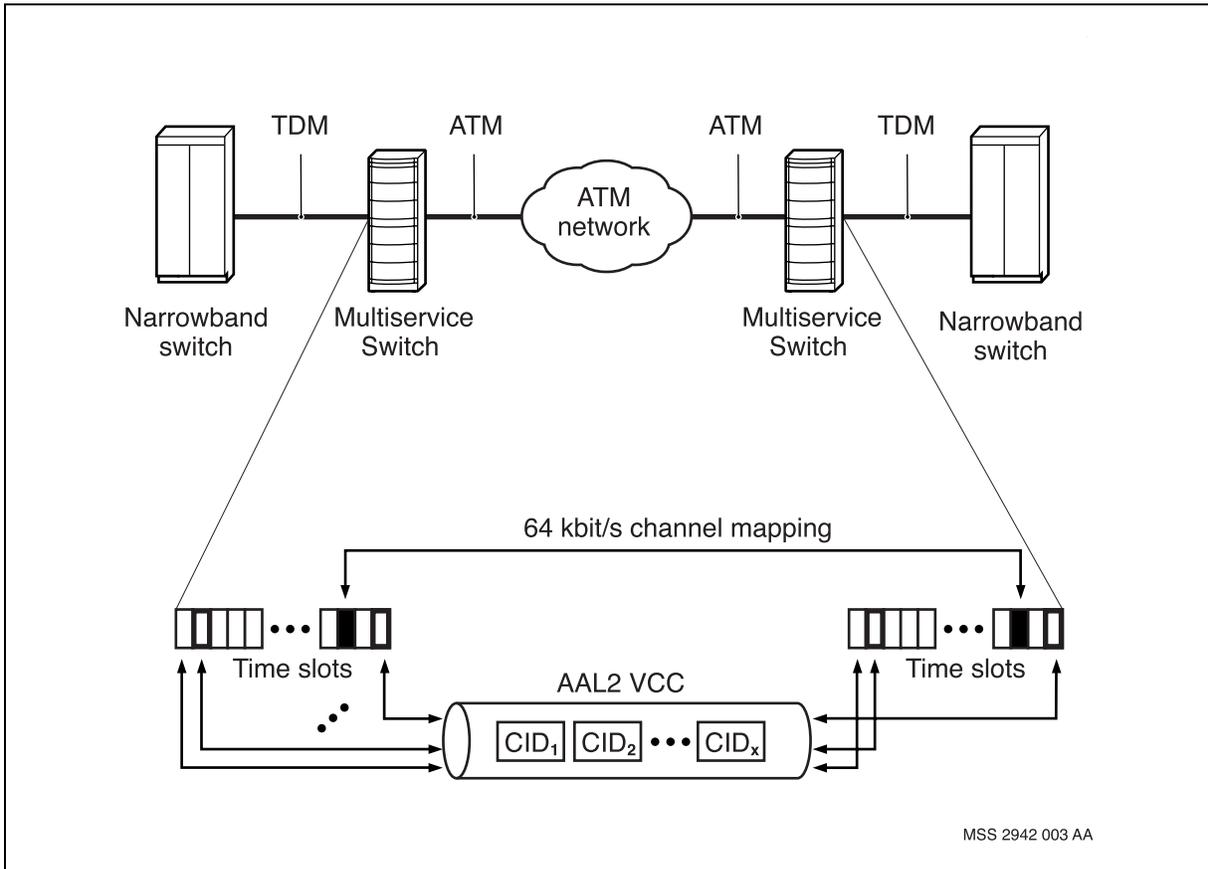
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# Non-switched Media Gateway using ATM functionality

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In non-switched Media Gateway, a narrowband call arriving at the Nortel Multiservice Switch node is statically mapped to a VCC. The VCC can be an ATM adaptation layer type 2 (AAL2) connection or an ATM adaptation layer type 5 (AAL5) connection. Calls are generally transported as AAL2 for voice data. If component *Nsta Conn Brag Ccst* is provisioned for CCS, the signaling data is transported end-to-end using AAL5. The call is transported in ATM cells through the ATM network to another Multiservice Switch node. At the remote end, it is mapped back to TDM time slots and passed to another narrowband node in the service provider's network. This configuration is shown in the figure [Non-switched Media Gateway application \(page 30\)](#).

**Non-switched Media Gateway application**



Non-switched Media Gateway using ATM can use the following ATM VCs to route the voice and voice band data traffic through the ATM network:

- a permanent virtual circuit (PVC)
- a provisioned switched virtual circuit (SVC)
- a provisioned soft permanent virtual circuit (SPVC)

See [ATM connections for Media Gateway \(page 112\)](#) for a description of how Media Gateway can use each type of ATM connection.

For ATM PVC use, each service interface time slot is statically mapped to a particular AAL2 channel identifier (CID) within an ATM VCC. When there is no call present in a time slot, another narrowband call using another time slot does not use the corresponding VCC/CID. The non-switched Media Gateway is transporting the narrowband call through an ATM PVC.

For narrowband services, such as voice and voice band data (fax and modem calls), Multiservice Switch Media Gateway transports traffic over AAL2 and AAL5 PVCs. AAL2 PVCs carry voice traffic and in-band signaling information. AAL5 PVCs carry out-of-band signaling information.

Non-switched Media Gateway using ATM can also use ATM PSVCs and SPVCs, to route the voice and voice band data traffic through the ATM network. See [ATM connections for Media Gateway \(page 112\)](#) for a description of how Media Gateway can use each type of ATM connection.

Support for PSVCs and provisioned SPVCs in non-switched Media Gateway is as follows:

- supported for voice services processor 2 (VSP2) and not VSP
- supported for Media Gateway-to-Media Gateway connections only
- supported for point-to-point ATM PSVCs and provisioned SPVCs and not point-to-multipoint
- transports CCS as CCD by provisioning timeslot 24 for DS1 and timeslot 16 for E1
- transports E1 CAS as CCD by provisioning timeslot 16
- no support for transporting CAS for DS1
- supports PVC, PSVC, and provisioned SPVC simultaneously
- supports ATM static routing user-to-network interface (UNI) 3.0/3.1/4.0
- supports ATM dynamic routing private network-to-network interface (PNNI) 1.0
- supports alarm indication signal (AIS) and remote defect indication (RDI)

To provision non-switched Media Gateways, see *Nortel Media Gateway 7480/15000 Non-switched Service Configuration Management* (NN10600-781). For more information about non-switched Media Gateway using ATM, see the following sections:

- [Introduction to Media Gateway 7480/15000 \(page 14\)](#)
- [Non-switched Media Gateway using ATM services for voice calls \(page 32\)](#)
- [Non-switched Media Gateway interworking function \(page 33\)](#)
- [Non-switched trunking using AAL2 \(page 34\)](#)
- [Congestion management for non-switched Media Gateway using ATM \(page 35\)](#)
- [CCS and CAS signaling transport \(page 37\)](#)
- [Standards compliance for non-switched Media Gateway \(page 39\)](#)

## Non-switched Media Gateway using ATM services for voice calls

Non-switched Media Gateway using ATM provides the following services for voice calls:

- [Voice compression algorithms supported by non-switched Media Gateway using ATM \(page 32\)](#)
- [Voice calls \(page 19\)](#)

### Voice compression algorithms supported by non-switched Media Gateway using ATM

Non-switched Media Gateway is compliant with two compression algorithms, G.726 adaptive differential pulse code modulation (ADPCM) and G.729a Conjugate Structure - Algebraic Code Excited Linear Prediction (CS-ACELP). See the following sections for more information:

- [G.726 voice call compression \(page 32\)](#)
- [G.729a voice call compression \(page 32\)](#)

#### G.726 voice call compression

Non-switched Media Gateway supports G.711 pulse code modulation (PCM) voice and G.726 ADPCM voice at 32, 24, and 16 kbit/s. Non-switched Media Gateway enables you to set the maximum and minimum voice rates.

By default, the maximum voice rate is 32 kbit/s ADPCM, which means that non-switched Media Gateway transmits voice calls at this rate when there is no congestion on the ATM link. By default, the minimum voice rate is 16 kbit/s ADPCM. During periods of heavy congestion, non-switched Media Gateway compresses voice calls to the minimum rate, and admits all new calls at this rate, until congestion is relieved. During periods of light to moderate congestion, non-switched Media Gateway can compress voice calls to a rate between the maximum and minimum voice rates.

#### G.729a voice call compression

Non-switched Media Gateway supports G.711 PCM voice at 64 kbit/s and CS-ACELP voice at 8 kbit/s. Non-switched Media Gateway enables you to set both minimum and maximum voice rates to either 8 kbit/s or 64 kbit/s. The default for minimum and maximum voice rate is 8 kbit/s.

When DTMF tones are detected, Media Gateway will upspeed from a G729 Annex A speed of 8 kbit/s to a G.711 speed of 64 kbit/s for the duration of the tone and then return to 8 kbit/s.

## Non-switched Media Gateway interworking function

A non-switched gateway uses Media Gateway software to provide standards-based multiplexing and de-multiplexing of AAL2 ATM VCCs and all voice band services. A non-switched gateway statically maps time slots from a TDM network onto AAL2 ATM VCCs. See figure [Non-switched ATM-to-TDM gateway bearer traffic path \(page 34\)](#).

The Nortel Multiservice Switch receives TDM data through a TDM FP. The FP de-multiplexes the incoming bit stream into standard 64 kbit/s channels and encapsulates them in AAL1 cells. The system then transfers these cells to the voice services FP for encoding. The Media Gateway identifies the cell streams as voice, fax/modem, or data calls. The Media Gateway can be provisioned for CAS, CCS, or no signaling types. See figure [Non-switched ATM-to-TDM gateway bearer traffic path \(page 34\)](#).

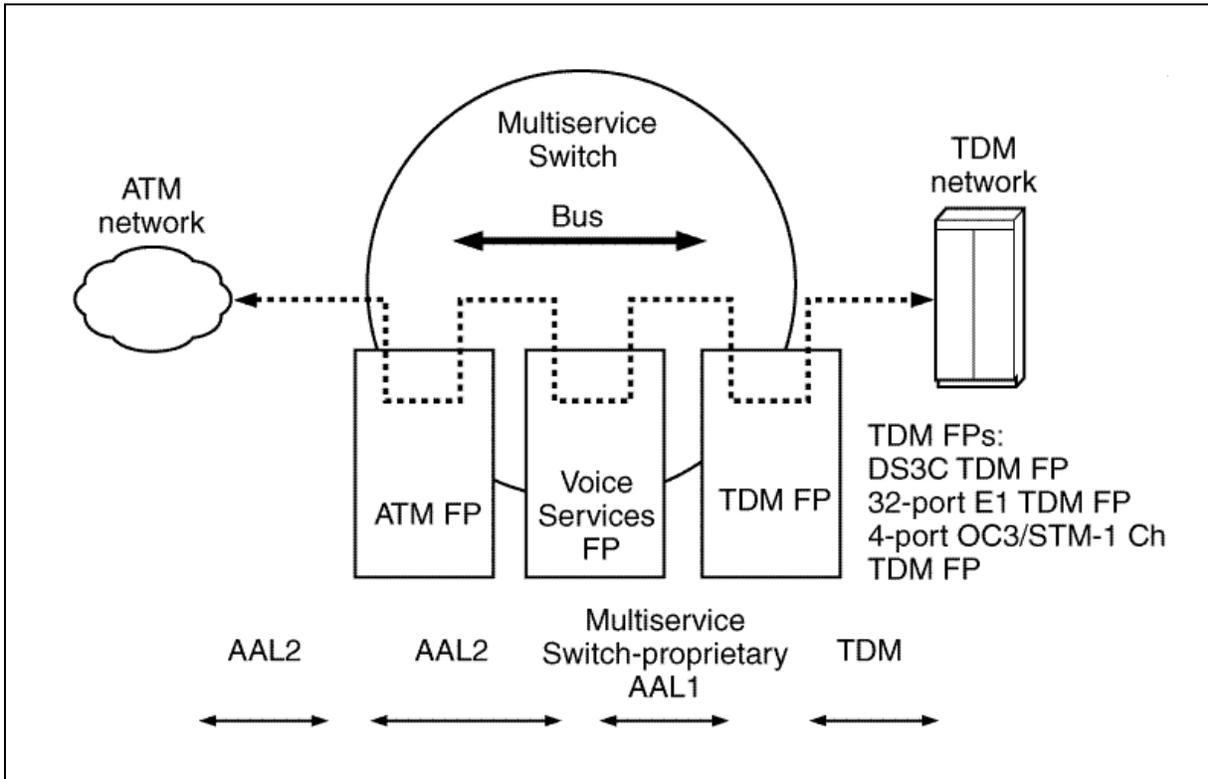
For information on which TDM FPs support non-switched Media Gateway, see *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference (NN10600-551)*.

CAS or CCS signaling may be transported using AAL2 voice channels configured for clear channel data or by using a 64kbit/s CES service over AAL1.

At the VSP, Multiservice Switch processes incoming cells according to the type of input and the attributes you have set. After the VSP processes the cell streams, it packages the input into AAL2 cells. The VSP transfers the AAL2 cells to an ATM FP. The ATM FP then transmits the AAL2 cells across the ATM link using PVC, SVCs, or SPVCs, whichever type of connection the network has been configured to use.

Media Gateway processes time slots from a TDM port and multiplexes them onto AAL2 ATM VCCs. It maps each TDM time slot to a statically configured AAL2 CID within an ATM VCC. See figure [Non-switched Media Gateway application \(page 30\)](#).

**Non-switched ATM-to-TDM gateway bearer traffic path**



**Non-switched trunking using AAL2**

The ATM Forum implementation agreement for ATM trunking using AAL2 describes two modes of operation: switched and non-switched. Media Gateway supports both non-switched trunking and proprietary switched trunking.

This section describes non-switched trunking. Switched trunking is described in [Switched Media Gateway using ATM functionality \(page 41\)](#).

Non-switched trunking does not terminate signaling, but instead transports it transparently. Media Gateway supports non-switched trunking using AAL2.

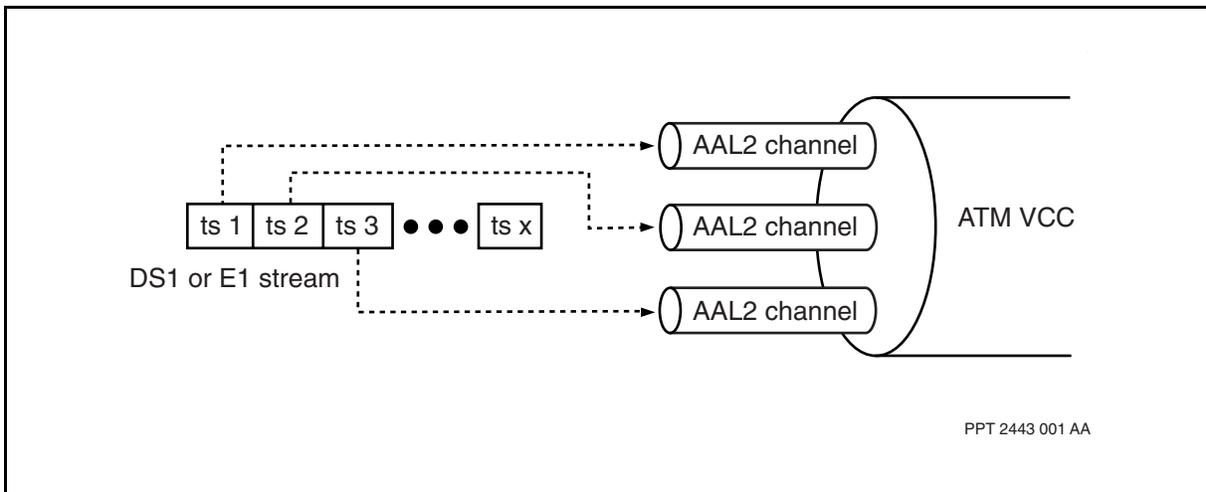
By default, each time slot within the service interface (DS1 or E1) maps to a statically configured AAL2 CID within an ATM VCC. See the figure [Non-switched ATM trunking using AAL2 \(page 35\)](#). The lowest numbered time slot corresponds to the first CID in the list, starting with CID number 8. Additional time slots increment the value of the CID. If you do not configure specific CID values, the system maps values based on the TDM trunk, as follows:

- A DS1 trunk with CCS uses CIDs 8 to 30.
- A DS1 trunk without CCS uses CIDs 8 to 31.

- An E1 trunk with CCS uses CIDs 8 to 37.
- An E1 trunk without CCS uses CIDs 8 to 38.

The CID mapped to each time slot depends on the type of signaling used. For CAS, each DS1 or E1 stream uses a separate AAL2 ATM VCC. For CCS, each DS1 or E1 channel uses two ATM VCCs: one AAL2 VCC carries the B channel; one AAL5 VCC carries the D channel.

### Non-switched ATM trunking using AAL2



## Congestion management for non-switched Media Gateway using ATM

Congestion management techniques prevent the system from transmitting too much traffic across the ATM link. Non-switched Media Gateway applies various congestion handling techniques at different congestion levels.

The speed at which Nortel Multiservice Switch nodes send data across the ATM link is determined by the call type, the level of congestion, and the configured values for peak cell rate (PCR), sustained cell rate (SCR), and maximum burst size (MBS). The values of PCR, SCR, and MBS are based on the quality of service required by the customer. See the chapter entitled [Traffic management for Media Gateway \(page 141\)](#) for details on calculating the values for PCR, SCR, and MBS.

Non-switched Media Gateway supports both dynamic compression and congestion triggered SAD techniques to reduce bandwidth requirements without impacting the voice traffic.

See the following sections for more information:

- [Congestion management with G.726 \(page 36\)](#)
- [Congestion management with G.729a \(page 36\)](#)

- [Connection admission control \(page 148\)](#)

### **Congestion management with G.726**

When there is no congestion on the ATM link, non-switched MG transmits voice calls at the maximum rate you have configured.

Voice call transport rates can change as congestion levels rise and fall. Non-switched MG allows you to set maximum and minimum voice call transport rates. During normal operation (no congestion), non-switched MG carries voice calls at the maximum rate. During heavy congestion, MG carries voice calls at the minimum rate. During light to moderate congestion, non-switched Media Gateway carries voice calls at rates between the maximum and minimum rates.

To gauge congestion levels, non-switched MG checks the number of cells the system transmits toward the ATM network at configured intervals. If the number of cells exceeds the congestion threshold, non-switched MG compresses voice calls to the rate that you configure for the system. If you have configured MG to apply silence suppression whenever the system experiences congestion, non-switched MG activates silence suppression on all voice calls on that link. The level of congestion is continuously rechecked. If the link is not congested, non-switched MG starts to upspeed active voice channels.

During periods of congestion, Nortel Multiservice Switch nodes admit new calls at the compressed rate that you have defined for the system. If the ATM link is still congested after the settling down period, the non-switched MG

- compresses some or all voice calls to the lowest configured rate, for example, 16 kbit/s ADPCM
- admits new calls only at this lowest rate, including data calls, if the number of data calls exceeds the number of data calls configured for the link

Non-switched MG maintains these levels of compression until the congestion level falls below the congestion threshold.

### **Congestion management with G.729a**

Regardless of congestion on the ATM link, non-switched MG transmits calls at the configured rate, either 8 kbit/s or 64 kbit/s. Non-switched MG transmits data calls at 64 kbit/s. Modem and fax calls are transmitted at 64 kbit/s PCM. Rate of transport for fax, modem, and data calls do not change except under heavy congestion.

To gauge congestion levels, non-switched Media Gateway checks the number of cells the system transmits toward the ATM network at configured intervals. Non-switched MG activates voice activity detection (VAD) on all voice calls if the number of cells exceeds the congestion threshold and the system has

been configured to apply VAD whenever congestion occurs. Non-switched Media Gateway continuously rechecks the level of congestion. If the link is still congested, non-switched Media Gateway admits new data calls at 64 kbit/s provided that it can downspeed the appropriate number of voice calls. If the G.729a standard is configured then upon congestion the VAD will be enabled and hence the data calls will be transported using the G.729 Annex B standard.

## CCS and CAS signaling transport

Non-switched Media Gateway provides transparent transport for CCS and CAS. It also supports unsignaled trunks. If you use CCS, non-switched Media Gateway can monitor signaling information to determine the type of call and the call state.

Non-switched Media Gateway software does not support CCS monitoring for E1 interfaces. For E1 interfaces, CAS can be transported as clear channel data only.

If SVCs, SPVCs, or the 4-port OC-3/STM-1Ch TDM/CES FP is used then CCS or CAS signaling transport over AAL5 is not available. However, both CAS and CCS signaling can be transmitted in AAL2 cells with PSVCs and provisioned SPVCs in a non-switched Media Gateway, as follows:

- CAS signaling for E1 can be transmitted in AAL2 cells by provisioning timeslot 16 (E1) to CCD.
- CCS signaling for DS1 or E1 can be transmitted in AAL2 cells by provisioning timeslot 24 (DS1) or 16 (E1) to CCD.

When CCS or CAS information is monitored, the system transports the bearer time slots only when they become active. With CCS monitoring, the connection type (voice, voice band data, or clear channel data) is determined by the signaling information (rather than the bearer data stream). CCS monitoring and CAS monitoring are not supported by non-switched Media Gateway for PSVCs and provisioned SPVCs.

---

**Attention:** If SVCs, SPVCs, or the 4-port OC-3/STM-1Ch TDM/CES FP is used then CCS or CAS signaling transport over AAL5 is not available.

---

If a timeslot is configured for clear channel data transport, the voice services FP does not perform voice processing on the bearer data (no voice codec, no upspeeding or downspeeding). The binary data is transported as is across the ATM network to the destination TDM network. If no voice codec function is desired then setting the timeslot for clear channel data is an option.

For more information, see the following sections:

- [Common channel signaling \(page 38\)](#)
- [Channel associated signaling for non-switched Media Gateway \(page 38\)](#)
- [Unsignaled trunks for non-switched Media Gateway using ATM \(page 39\)](#)

### **Common channel signaling**

If you use CCS, non-switched Media Gateway maps each D channel to an AAL5 ATM VCC. Non-switched Media Gateway maps each B channel to a channel on an AAL2 ATM VCC. Non-switched Media Gateway interprets CCS signaling information and does the following:

- suppresses idle channels and does not transmit them over the ATM link
- transmits uncompressed digital data channels
- compresses and transmits voice channels according to how you configure the system

Monitored or unmonitored CCS DS1s contain 23 64 kbit/s bearer channels while unmonitored E1s contain 30 64-kbit/s bearer channels. (Non-switched Media Gateway software does not support CCS monitoring for E1 interfaces.) DS1s that do not use CCS contain 24 64-kbit/s bearer channels. E1s that do not use CCS contain 31 64-kbit/s bearer channels.

CCS in Media Gateway, is the use of D-channel signaling for the bearer B-channels of a primary rate interface (PRI) circuit.

Non-switched Media Gateway supports CCS transport by provisioning timeslot 24 on the DS1 or timeslot 16 on the E1 as a CCD timeslot.

---

**Attention:** If SVCs, SPVCs, or the 4-port OC-3/STM-1Ch TDM/CES FP is used then CCS signaling transport over AAL5 is not available.

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### **Channel associated signaling for non-switched Media Gateway**

If you use DS1 CAS, non-switched Media Gateway maps the AB/ABCD signaling bits to the same AAL2 ATM VCC as the data. There are signaling bits in every sixth frame of a superframe (12 consecutive frames) or extended superframe (24 consecutive frames). For DS1 trunks, bit 8 of each traffic channel time slot is the signaling bit.

For E1 trunks, only timeslot 16 carries the signaling information. E1 CAS can be transported by configuring the system to transport timeslot 16 as clear channel data.

You can configure one or more CAS DS0s. The CAS signaling handler

- interprets CAS signaling information to determine when a channel is active. Non-switched Media Gateway does not transmit idle channels.
- transmits signaling bits only when a call state changes

### **Unsignaled trunks for non-switched Media Gateway using ATM**

Non-switched Media Gateway supports unsignaled trunks. When a DS1 or E1 TDM stream does not contain signaling, or if you are signaling over another connection or network (for example, over SS7 signaling links) you can configure all the channels on the trunk as unsignaled and use the full bandwidth on the ATM link to transport bearer channels. If the TDM stream contains any type of signaling (for example, PRI D-channel signaling or E1 CAS, which is transported in time slot 16), you can configure the system to transport that signaling over the ATM link by configuring one or more time slots as clear channel data. CAS information cannot be monitored over unsignaled trunks.

With the 4-port OC-3/STM-1Ch TDM/CES FP CCS and E1 CAS information can be transported using AAL1 CES. The TDM trunks in the VSP are configured as unsignaled trunks and the signaling channel is bypassed by the VSP. There is a limitation of 64 TDM to VSP connections per VSP2.

## **Non-switched Media Gateway using ATM on Multiservice Switch 15000**

There is a capacity issue with CAS-monitored voice trunks when used with Nortel Multiservice Switch 15000 Media Gateway in the non-switched voice mode. Nortel Networks recommends you provision no more than 15-CAS monitored trunks on a single voice services processor 2 (VSP2) card. There is no restriction on the number of CAS-unmonitored, CCS-monitored/unmonitored, or unsignaled trunks that can be configured.

## **Standards compliance for non-switched Media Gateway**

Non-switched Media Gateway complies with the following voice, ATM, and signaling standards:

- ITU-T G.711
- ITU-T G.164
- ITU-T G.165
- ITU-T G.168
- ITU-T G.726. The 40 kbit/s compression mode is not implemented.
- ITU-T G.729 Annex A and B. Compliant with VAD and voice compression only.
- ITU-T Recommendation T.30

- ITU-T Recommendation I.363.2
- BTD-VTOA LLTAAL2-0.01
- AT&T Technical Report 41459
- AT&T Technical Report 41458

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**Attention:** Either the ITU-T G.726 standard or G.729 A and B standard can be used with non-switched Media Gateway.

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For standards compliance information, see *Nortel Multiservice Switch 7400 Fundamentals – Hardware* (NN10600-170) or *Nortel Multiservice Switch 15000/20000 Fundamentals – Hardware* (NN10600-120). For standards compliance for the ATM Core service, see *Nortel Multiservice Switch 7400/15000/20000 ATM Fundamentals* (NN10600-700).

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# Switched Media Gateway using ATM functionality

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In switched MG using ATM, an interworking function (IWF) terminates narrowband signaling. This method allows Nortel Multiservice Switch MG to dynamically create voice and voice band data connections between the service provider's TDM network and the ATM network. Incoming TDM time slots are dynamically mapped to outgoing AAL2 CIDs within an ATM VCC for each call. This mapping can also occur in the reverse direction with incoming ATM VCCs/CIDs being mapped to outgoing TDM time slots.

For switched MG using ATM, the IWF consists of the following three parts:

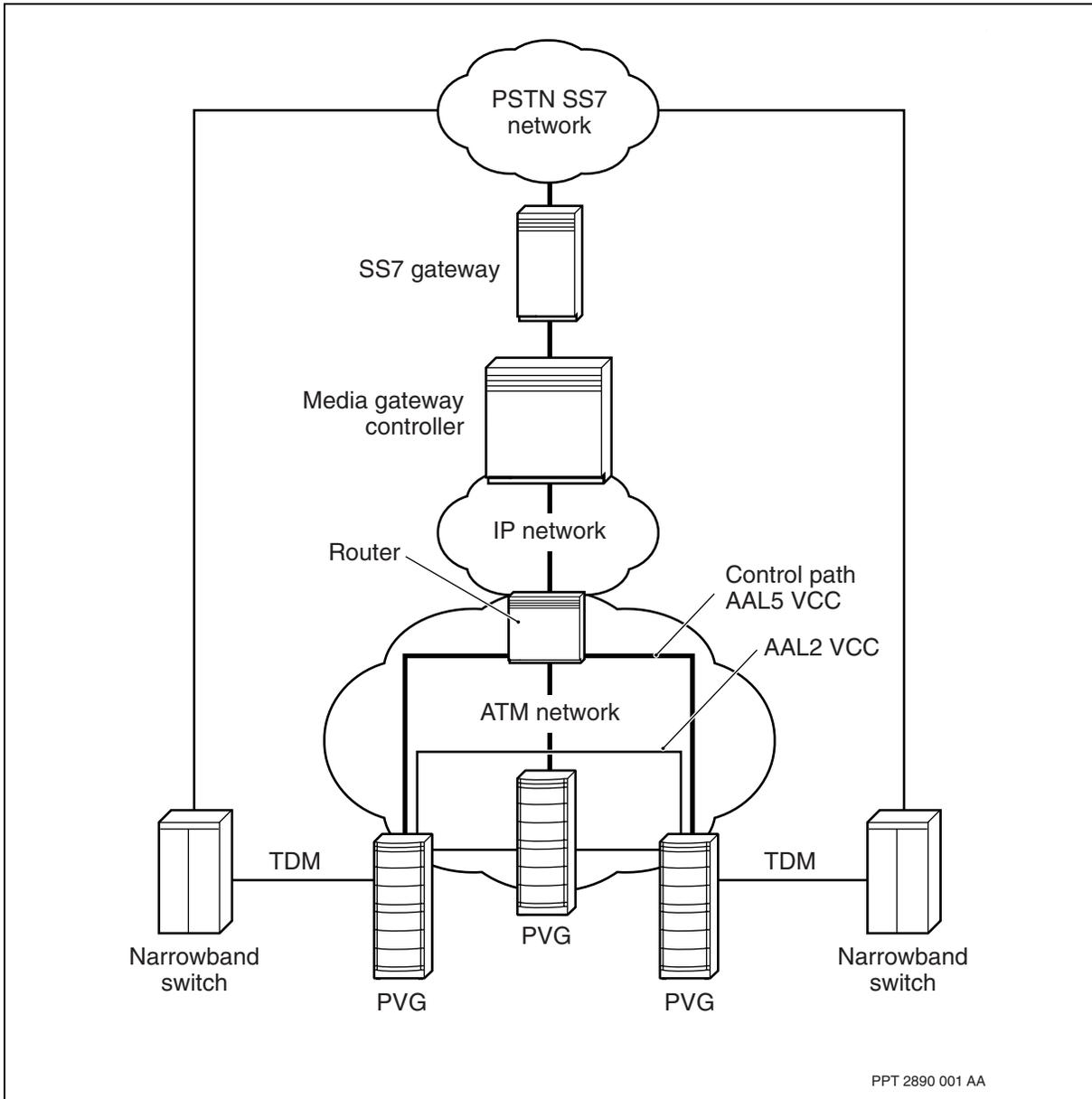
- a voice gateway service (provided by Multiservice Switch MG)
- a Media Gateway controller (MGC) (provided by third-party equipment)
- an SS7 gateway (also provided by third-party equipment)

The relationship between each element in the interworking function is shown in the figure [Switched MG using ATM \(page 42\)](#). Multiservice Switch MG performs the role of the voice gateway service, which handles all the bearer traffic functionality using AAL2 VCCs. The MGC handles all the signaling and call control functionality between the PSTN and Multiservice Switch MG. The SS7 gateway provides the controller with links into the SS7 network. Control traffic between each element is carried over an IP network, with Multiservice Switch MG connecting with the IP network on a single AAL5 VCC.

Switched MG using ATM can use ATM PVCs, provisioned SVCs or SPVCs to route the voice and voice band data traffic through the ATM network. See [ATM connections for Media Gateway \(page 112\)](#) for a description of how MG can use each type of ATM connection.

Switched MG using ATM can also use ATM SVCs to route the voice and voice band data traffic through the ATM network.

**Switched MG using ATM**



To provision switched MG using ATM, see [Installing and setting up Media Gateway \(page 131\)](#) and [Nortel Media Gateway 7480/15000 Switched Service Configuration Management \(NN10600-782\)](#). For more information about switched MG using ATM functionality, see the following sections:

- [Introduction to Media Gateway 7480/15000 \(page 14\)](#)
- [Switched MG using ATM services for voice calls \(page 43\)](#)
- [Switched ATM-to-TDM gateway \(page 46\)](#)

- [Unsignaled trunks for switched MG using ATM \(page 46\)](#)
- [Local traffic switching for switched MG using ATM \(page 46\)](#)
- [Call control for switched MG using ATM \(page 47\)](#)
- [Switched Media Gateway using ATM or IP functionality \(page 68\)](#)

## Switched MG using ATM services for voice calls

Switched Media Gateway supports the following voice services:

- [Voice compression for switched MG using ATM \(page 43\)](#)
- [Packet features using VSP2/VSP3/VSP3-o and ATM functionality \(page 45\)](#)
- [Voice calls \(page 19\)](#)
- [Switched MG using ATM or IP services for voice calls \(page 68\)](#)

## Voice compression for switched MG using ATM

Switched MG using ATM is compliant with three standards of voice compression. The G.711 standard, the G.726 ITU standard, or the G.729 Annex A and B standard can be provisioned for switched MG using ATM.

The MG15000 supports the following codecs for VoATM:

- 64kG711A (5ms)
- 64kG711U (5ms)
- 32kG726ITU (5ms & 10ms)
- 24kG726ITU (5ms & 10ms)
- 8kG729 (10ms)

---

**Attention:** The enumerated range that can be provisioned in the `tone2100Rate` has been modified such that 32kG726 has been sub-divided into ITU and IETF variants (32kG726ITU and 32kG726IETF) and only the ITU variant is allowed for VoATM.

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**Attention:** For VoATM, the `defaultCodecList` attribute replaces the `defaultVoiceRate` attribute and continues to provide the same functionality that the `defaultVoiceRate` attribute provided in past releases. For VoATM networks, the `defaultCodecList` can contain only one value. That single value can be any of the supported codecs per the feature list on that card and not only the G.711A value. See [Codecs and the defaultCodecList \(page 69\)](#) for more information about manipulating the `defaultCodecList`.

---

See the following sections for more information:

- [G.711A and G.711U voice call compression \(page 44\)](#)
- [G.726ITU voice call compression \(page 44\)](#)
- [G.729 Annex A and B voice call compression \(page 44\)](#)

### **G.711A and G.711U voice call compression**

Switched MG for ATM uses G.711A which supports A-law PCM voice and G.711U which supports Mu-law at 64 kbit/s. The values of the 64kG711 codec have been split into 64G711A and 64G711U to account for the packet log law used for the G711 codec. When VoATM features are provisioned in the featureList, the defaultPacketLogLaw attribute must be set to either ALaw or MuLaw only. This value must be in sync with the G711 codec provisioned in the defaultCodecList. For example, if the defaultCodecList is set to 64kG711A, then the defaultPacketLogLaw must be set to A-Law.

### **G.726ITU voice call compression**

Switched Media Gateway using ATM supports ADPCM voice at 32 kbit/s. Using the G.726ITU standard for VBD only applies to AAL2 traffic. MG15000 uses the AAL2 profile 3 selection logic to carry out H.248 call control in accordance with the I.366.2 Annex P.3 AAL2 Codec Profile 3.

MG supports the G.726-24KITU (5ms and 10ms) codec over AAL2 on the H.248 protocol. The G.726-24KITU (5ms and 10ms) codec provides more functionality for low bandwidth codecs than that offered with the G.729 codec and delivers more robust functionality over multiple hops than the G.729 codec. The G.726-24KITU codec for AAL2 allows CS2000 solutions to meet the voice quality requirements that high compression codecs such as G.729 do not meet.

Upspeeding to G.711 is required and supported when voice band data (VBD) is detected. When the MG15000 goes to the VBD state it upspeeds its codec (if necessary) to a higher rate codec (G.711), switches off its silence suppression (if it is on), and uses a fixed de-jitter buffer.

### **G.729 Annex A and B voice call compression**

Switched MG using ATM supports PCM voice at 64 kbit/s and CS-ACELP voice at 8 kbit/s. Support of the G.729 Annex A and B voice call compression has the following considerations:

- not supported for packet loss concealment (PLC)
- supports upspeeding for fax/modem, DTMF, and CNG
- supports squelch for DTMF (squelch removes DTMF signal from encoded voice path)
- supports G.729 Annex A and B in codec selection negotiation

- supported for VSP2 on Nortel Multiservice Switch 7400 (720-DS0 channel capacity) nodes, and on Multiservice Switch 15000 (800-DS0 channel capacity) nodes
- supported for VSP3 on Multiservice Switch 15000 and (1512-DS0 channel capacity) nodes
- supported for VSP3 with optical TDM interface (VSP3-o) on Multiservice Switch 15000 and nodes with the following channel capacities:
  - 1953 channels of STM-1
  - 2016 channels for OC-3
- supports simultaneous transmission of DTMF tones and digit collection
- supports DTMF Relay over AAL2
- supports I.366.2 Annex P profile 7 (5-ms G.711, 10-ms G.729, and G.729 silence insertion descriptor (SID))
- supported for H.248 version 1 protocol

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**Attention:** The VSP3-o FP card only supports the H.248 version 1 protocol.

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When DTMF tones are detected, MG will upspeed from a G729 Annex A speed of 8 kbit/s to a G.711 speed of 64 kbit/s for the duration of the tone and then return to 8 kbit/s.

---

**Attention:** G.729 Annex A and B encoding is a G.729 Annex A compression standard with a G.729 Annex B standard of VAD enabled.

---

### **Packet features using VSP2/VSP3/VSP3-o and ATM functionality**

Switched MG using ATM functionality and using the VSP2/VSP3/VSP3-o FPs, supports the following packet features:

- Detect 2100 Hz tones with and without phase reversal on the packet side and on the TDM side. The MG can determine if the 2100 Hz tone is from the packet side or from the TDM side. The packet side can have VoIP or VoATM packets.
- Indicate a profile in the session description protocol (SDP) in accordance with standard RFC 3108 of the Internet Engineering Task Force (IETF).

## Switched ATM-to-TDM gateway

The basic gateway mechanism is explained in [Non-switched Media Gateway interworking function \(page 33\)](#). A switched MG is similar to a non-switched MG except in the following areas:

- The switched MG dynamically maps time slots from a TDM network onto AAL2 ATM VCCs.
- The switched MG can use ATM PVCs, provisioned SVCs, and SPVCs to route the voice and voice band data traffic through the ATM network.
- The switched MG can also use ATM SVCs to route the voice and voice band data traffic through the ATM network.
- The switched MG uses an interworking function consisting of a voice gateway service and a MGC to terminate signaling traffic from the PSTN.
- The VSP2/VSP3/VSP3-o FPs process incoming cells according to the type of input, the attributes you have set, and the switching instructions received from the MGC. See [Signaling between the narrowband network and MG for switched MG using ATM \(page 46\)](#).

See also [Switched MG using ATM \(page 42\)](#).

## Signaling between the narrowband network and MG for switched MG using ATM

Signaling between the narrowband network and MG is handled by an SS7 gateway and a MGC. When using H.248 to make a bearer traffic connection in the MG, the MGC sends an ADD command with the appropriate parameters to the MG. In Nortel Multiservice Switch MG, the VSP-type (VSP2, VSP3, or VSP3-o) FP acts on instruction from the MGC to make or break narrowband connections between TDM trunks and AAL2 trunks.

For more information about the control connections between Nortel Multiservice Switch MG and the MGC, see [Call control for switched MG using ATM \(page 47\)](#).

## Unsignaled trunks for switched MG using ATM

Switched MG using ATM supports unsignaled trunks. When an E1 or DS1 TDM stream contains no signaling, or if you are signaling over another connection or network (for example, over SS7 signaling links) you can configure all the channels on the trunk as unsignaled and use the full bandwidth on the ATM link to transport bearer channels.

## Local traffic switching for switched MG using ATM

Nortel Multiservice Switch MG supports local traffic switching through AAL2. Local traffic switching through AAL2 means to originate and terminate a TDM-to-TDM call on the same VSP2/VSP3/VSP3-o FP (also called TDM-

TDM hairpinning) or on separate VSP2/VSP3/VSP3-o FPs on the same shelf. MG supports local traffic switching through AAL2 using virtual channel connections (VCC) to either of the following:

- internal switching across the backplane of a Nortel Multiservice Switch 7400 node or across the fabric cards of Multiservice Switch 15000 nodes
  - Internal switching is configured through provisioned switched virtual circuits (SVC) connections using active access points (AAP) and passive access points (PAP). See [ATM connections for Media Gateway \(page 112\)](#) for a description of how MG can use each type of ATM connection.
  - Internal switching method must have each end of the VCCs provisioned on the Multiservice Switch MG as separate ATM connections with adjacent virtual channel connection identifiers (VCCI) of an even number and the next greater sequential number (for example, 100 and 101). As well, the remote network service access point (NSAP) address must be set to the local NSAP address value. The gateway recognizes its own address in an incoming session descriptor and swaps the VCCI values accordingly in the outgoing session descriptor. When a gateway is selecting a trunk and receives a session descriptor with a remote address that is identical to the local address, it considers only even numbered VCCIs that have matching equivalent odd numbered VCCIs.
- external switching through the external ATM network
  - External switching is configured through provisioned soft permanent virtual circuit (SPVC) connections that use SPVC access points (SPVCAP). The SPVC connections must be made using two separate VSP2/VSP3/VSP3-o FPs to process the origination and termination of the TDM-to-TDM call. See [ATM connections for Media Gateway \(page 112\)](#) for a description of how an MG can use each type of ATM connection.

---

**Attention:** The recommended method is to use internal switching across the backplane of Multiservice Switch 7400 nodes, or across the fabric cards of Multiservice Switch 7400 nodes, and not use external switching through the external ATM network.

Please contact Nortel support if external switching is required for your configuration.

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## Call control for switched MG using ATM

The MGC is responsible for terminating the signaling received from the PSTN through the SS7 gateway.

When the MGC receives signaling information, it sends the appropriate commands for call establishment, release, and maintenance to the MG through a single control link to the VSP2/VSP3/VSP3-o FP. The control protocol for sending commands between the MGC and Nortel Multiservice Switch MG is H.248.

The following sections describe the various aspects of the MGC:

- [MGC connections for switched MG using ATM \(page 48\)](#)
- [Communication between MGCs for switched MG using ATM \(page 49\)](#)
- [PRI backhaul for switched MG \(page 80\)](#)
- [EN 300 V5.2 backhaul for switched MG \(page 83\)](#)
- [SS7 Backhaul for switched Media Gateway \(page 87\)](#)
- [Voice profiles \(page 49\)](#)

### **MGC connections for switched MG using ATM**

Call control connections can be configured as follows:

- [AAL5 VCC configuration for call control connections \(page 48\)](#)

### **AAL5 VCC configuration for call control connections**

Control traffic travels over an IP network. Each Nortel Multiservice Switch MG connects with the IP network using a single AAL5 VCC. This VCC carries IP datagrams using RFC 2684 encapsulation and terminates on an IP router that has an ATM interface. The router supports the inverse ATM address resolution protocol (inATMARP), which allows the router to discover the binding between the configured PVC and the IP address of the control interface on the MG. The MG sends an inATMARP request message once the IP address is provisioned.

VSP FPs (VSP2, VSP3, VSP3-o, or 2pVSP4e) must be linked with AAL2 VCCs (PVCs) to successfully establish calls. Therefore, all voice calls can be directly routed over a single VCC from an originating MG (where conversion from TDM takes place) to a terminating MG (where conversion back to TDM takes place).

Each PVC FP is labeled with an identifier that is identical at both ends of the connection. This identifier is referred to as the VCCI and is used in the process of establishing calls. For the originating and terminating MGs to connect their respective TDM end points to the same CID in the same VCC for the same call, communication between the two MGs is required. Each MG needs to know the following information:

- the identity of its remote peer (formatted as a network service access point (NSAP) address)
- the VCCI for each VCC connecting the two gateways

- the CID for each AAL2 channel
- the voice profile (including information such as the maximum number of channels that can be assigned for a particular VCC)

When using H.248, the status of the MGC to MG connection is controlled by ServiceChange commands. MG brings the connection into service by sending a cold boot (ServiceChange command with reason 901 cold boot) and the link is established after an Acknowledge has been received from the MGC. To check for inactivity, an inactivity timer is set by the MGC on MG. If MG does not detect any messages for the defined period of time, it will send a time-out message (a H.248 observed event). If the MG does not reply after a provisioned number of attempts and has not received any other messages from the MGC, the MG will “failover”. In a Succession Networks application, a ServiceChange command with reason disconnect is sent to the MGC until an acknowledgement is received.

### **Communication between MGCs for switched MG using ATM**

Communication between two MGs is achieved through the exchange of session descriptors. When a call is to be setup, the originating MG produces a session descriptor with its ATM NSAP address specified and the VCCI and CID fields left blank. The MG also sets the voice profile to a list of the profiles that it supports. This session descriptor is delivered, through the media gateway controller, to the terminating MG. The terminating MG selects an available VCCI and CID and an appropriate voice profile, includes its own ATM NSAP address, and returns the session descriptor through the media gateway controller. At this point, associations between TDM time slots and CIDs within a VCC can be dynamically established.

### **Voice profiles**

The voice profile of a call is specified by a message from the MGC to the MG through the SDP. Voice and voice band data (VBD) use voice profiles as an agreement on how to interpret the contents of packets in both the transmitting and receiving directions.

MG supports the following voice profiles:

- ITU I.366.2 standard profile P-1: G.711U 64-kbit/s mu-law PCM without silence suppression for both voice calls and VBD calls. Data is carried in 40-byte packets with 5 ms packet data samples.
- ITU I.366.2 standard profile P-2: G.711U 64-kbit/s Mu-law PCM with silence suppression supported for voice calls only. The SID indicates the need for comfort noise when silence suppression is used. No silence suppression is used for VBD calls. Data is carried in 40-byte packets with 5 ms packet data samples.

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# Switched Media Gateway using IP functionality

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Switched MG using IP functionality (VoIP) is a configuration to connect the MG to the IP network. The VoIP configuration uses one of the following transport applications:

- ATM transport application
- Ethernet transport application

In addition to the transport application, VoIP uses one of the following routing methods:

- an external router
- virtual routing (VR) functionality
- VR interworking functionality through component *VirtualRouterAccessPoint (VrAp)*; also referred to as VR AP

For information on VoIP using ATM transport applications see

- [VoIP using ATM transport and external routing \(page 51\)](#)
- [VoIP using ATM transport and VR \(page 53\)](#)

For information on VoIP using Ethernet transport applications see

- [VoIP using two gigabit Ethernet ports of VSP3 and external routing \(page 53\)](#)
- [VoIP using Ethernet transport and VR \(page 53\)](#)
- [VoIP using Ethernet transport and VR on Multiservice Switch 7400 and Multiservice Switch 15000 VSS nodes \(page 55\)](#)

For details on services for switched MG using IP, see the following sections:

- [Introduction to Media Gateway 7480/15000 \(page 14\)](#)
- [Voice compression for VoiP \(page 57\)](#)
- [Switched ATM-to-TDM gateway \(page 46\)](#)

- [DTMF relay \(page 62\)](#)
- [Fax relay \(page 62\)](#)
- [VBD terminal support \(page 63\)](#)
- [VoIP services for voice calls \(page 64\)](#)
- [Call control for VoIP \(page 66\)](#)
- [Switched Media Gateway using ATM or IP functionality \(page 68\)](#)
- [IPSec for switched MG call control connections in a Carrier VoIP Network \(page 67\)](#)

To provision VoIP, see [Installing and setting up Media Gateway \(page 131\)](#) and *Nortel Media Gateway 7480/15000 Switched Service Configuration Management* (NN10600-782).

## VoIP using ATM transport and external routing

MG connects with the IP network using ATM. MG converts TDM traffic to IP and encapsulates the IP in ATM AAL5 cells for transport through the ATM network to the IP network.

In VoIP using ATM transport and external routing, an interworking function (IWF) terminates narrowband signaling in a manner similar to that of switched MG using ATM. This method allows Nortel Multiservice Switch MG to dynamically create voice and voice band data connections between the service provider's TDM network and the IP network. Incoming TDM time slots are dynamically mapped or switched to outgoing UDP ports for each call. This mapping can also occur in the reverse direction, with incoming UDPs being switched to outgoing TDM time slots.

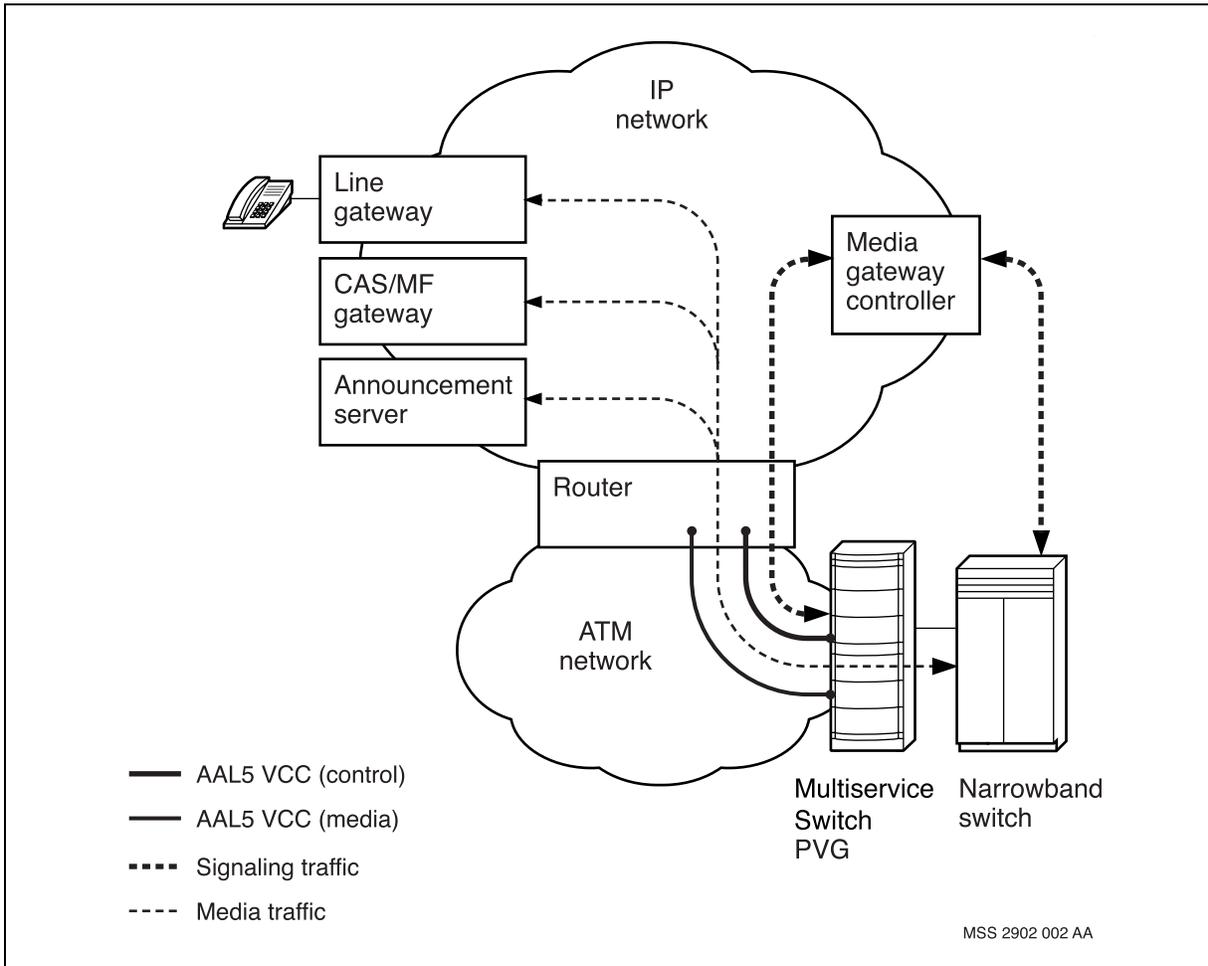
For VoIP, the interworking function consists of the following two parts:

- a voice gateway service (provided by Multiservice Switch MG)
- an MGC such as Nortel Networks Succession Networks CS2000 or CS2000 Compact

The relationship between each element in the interworking function is shown in [VoIP using ATM transport and external routing \(page 52\)](#).

VoIP using ATM transport and external routing can use PSVCs or SPVCs to route the voice and voice band data traffic through the ATM network to the IP interface. See [ATM connections for Media Gateway \(page 112\)](#) for a description of how an MG can use each type of ATM connection.

**VoIP using ATM transport and external routing**



Bearer traffic travels over the IP network using RTP/UDP/IP. When using H.248 to make a bearer traffic connection in the MG, the MGC sends an ADD command with the appropriate parameters to the MG. In the Media Gateway, the voice services FP acts on instructions from its MGC to make or break narrowband connections between TDM trunks and IP flows.

VoIP using ATM transport and external routing is supported on the following types of voice services processor cards:

- VSP2 FP
- VSP3 FP
- VSPs-o FP with optical TDM interface
- 2pVS FP

## VoIP using ATM transport and VR

MG connects with the IP network using virtual router access point (VR AP) functionality. MG sends TDM traffic to the IP network as IP through VR AP functionality and an ATM IP FP card (four port OC-3 ATM IP FP or four port OC-12 ATM IP FP).

---

**Attention:** VSP hitless equipment protection (HEP) and hitless software migration (HSM) are supported in the VoIP using ATM transport (4-port OC-3/STM-1 ATM FP and 4-port OC-12/STM-4 ATM FP) and VR configuration.

---

## VoIP using two gigabit Ethernet ports of VSP3 and external routing

MG connects with the IP network using the two gigabit Ethernet ports of the VSP3 FP. MG sends TDM traffic to the IP network as IP through the gigabit Ethernet ports of the VSP3 FP card. A router is required for connectivity to other subnets. A router that also supports bridging is the recommended router for a direct connection from the IP network to the two port gigabit Ethernet ports of the VSP3 FP.

To configure VoIP using two gigabit Ethernet ports of VSP3 and external routing, you must install a Nortel Multiservice Switch 15000 node that contains the following:

- at least one VSP3 FP
- at least one four port OC-3/STM-1Ch TDM/CES FP, two port DS3Ch TDM FP, or 32-port E1 TDM FP
- one or two CPs

---

**Attention:** VSP3 gigabit Ethernet ports support media traffic and support call control signaling to the MGC. VSP3 gigabit Ethernet ports do not support operations, administration, and maintenance (OAM) activities.

---

## VoIP using Ethernet transport and VR

MG connects with the IP network using virtual router (VR) interworking functionality through component *VirtualRouterAccessPoint (VrAp)*. MG sends TDM traffic to the IP network as IP through VR interworking functionality and a four port gigabit Ethernet FP card (4pGe).

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**Attention:** VSP HEP is supported for VoIP using Ethernet transport (4pGe card) and VR configuration. VSP HEP is not supported for VoIP over Ethernet when Ethernet ports on VSP3 card are used.

---

To configure VoIP using Ethernet transport and VR interworking, you must install a Nortel Multiservice Switch 15000 node that contains the following:

- at least one VSP2, VSP3, VSP3-o, or 2pVSP4e FP
- between one and three of the four port OC-3/STM-1Ch TDM/CES FP cards (only when using VSP2/VSP3 FP cards and not using VSP3-oor 2pVSP4e FP cards)
- one or two CPs
- at least one four port gigabit Ethernet FP card (4pGe, NTHW49); see [4pGe FP card support of VoIP \(page 54\)](#)

---

**Attention:** Carrier grade support requires a minimum of two CP cards, two VSP-type FP cards, two TDM FP cards (if using VSP2/VSP3), and two 4pGe FP cards.

---

#### 4pGe FP card support of VoIP

The 4pGe card of MG supports VoIP using Ethernet transport and VR as follows:

- uses DiffServ (differentiated service) to manage IP traffic to VR interfaces (DiffServ supports egress treatment only on gigabit Ethernet link)
- provides inter-VR connectivity of media traffic through the virtual media (VM) application (connects multiple VRs and multiple VSP-type cards on the same MG)
- supports a maximum of four VRs per 4pGe card
- provides carrier grade support; see [4pGe FP card support of carrier grade \(page 54\)](#)

#### 4pGe FP card support of carrier grade

Carrier grade features are supported on the 4pGe card for switched MG using IP functionality and virtual router (VR) interworking through component *VirtualRouterAccessPoint (VrAp)*. The 4pGe card supports carrier grade as follows:

- recovery from port/card failure with a maximum of 1 s of IP traffic loss from moment of failure
- HSM with a maximum of 1 s of IP traffic loss from the moment of the switch between shelf running old software and shelf running new software (supported for traffic originating on the MG)
- CPSO with a maximum of 50 ms of IP traffic loss when using static routes and open shortest path first (OSPF) routes (OSPF are dynamic routes)

Carrier grade support by the 4pGe card in a configuration of switched MG using IP (VoIP) with Ethernet transport and VR, has the following considerations:

- support of carrier grade on the Nortel Multiservice Switch 15000 nodes only
- protection of static IP routes using protected default route (PDR) for IP forwarding
- protection of dynamic IP routes (OSPF) using protected routes configuration for IP forwarding
- protection of 4pGe ports and bandwidth aggregation using link aggregation (LAG) protocol of grouped Ethernet ports
- hot CPSO support

## VoIP using Ethernet transport and VR on Multiservice Switch 7400 and Multiservice Switch 15000 VSS nodes

MG connects with the IP network using Ethernet transport and VR functionality. MG sends TDM traffic to the IP network as IP through VR functionality. This implementation is only available on Nortel Multiservice Switch 7400 or Nortel Multiservice Switch 15000 Variable Speed Switch (VSS) nodes.

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**Attention:** The VR functionality used by this configuration is different than VR AP functionality used in section [VoIP using Ethernet transport and VR \(page 53\)](#).

---

To configure VoIP using Ethernet transport and VR on Multiservice Switch 7400, you must install a Multiservice Switch 7400 node that contains the following:

- one or two VSP2 FPs
- one or two ATM FPs. The OC-3/STM-1 ATM IP FP is recommended.
- one or two of the 2-port DS3Ch TDM FP or 32-port E1 TDM FP
- between one and four 2-port 100BaseT Ethernet FPs
- one or two control processors

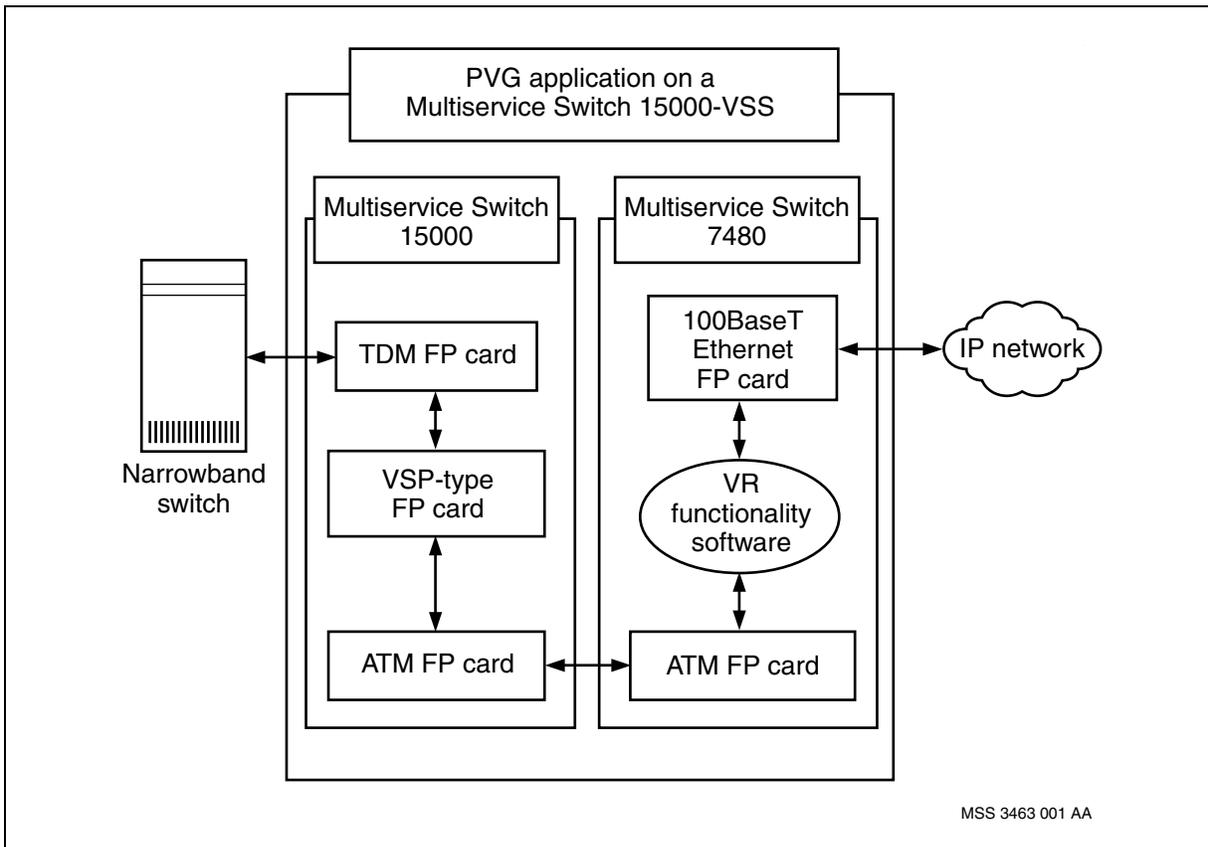
To configure VoIP using Ethernet on Multiservice Switch 15000 VSS, you must install a Multiservice Switch 15000 VSS node that contains the following:

- On the Multiservice Switch 7400 node
  - between one and three ATM FPs. The OC-3/STM-1 ATM IP FP is recommended.

- between one and eight 2-port 100BaseT Ethernet FPs
- one or two control processors
- On the Multiservice Switch 15000 VSS node
  - one or two OC-3/STM-1 FPs
  - between one and four of either the VSP2 FP or VSP3 FP
  - between one and three of either the 2-port DS3Ch TDM FP, 32-port E1 TDM FP, or 4-port OC-3/STM-1Ch TDM/CES FP
  - two control processors

The relationship of the two shelves of the Multiservice Switch 15000 VSS for VoIP using Ethernet is shown in [VoIP using Ethernet transport and VR on Multiservice Switch 15000 VSS \(page 56\)](#).

### VoIP using Ethernet transport and VR on Multiservice Switch 15000 VSS



The following software is required for the VoIP using Ethernet transport and VR configuration:

- the base application and its atmCore feature

- the MG application and its nsta and vgsip features if two 2-port DS3Ch TDM FPs or 32-port E1 TDM FPs are used
- the WanDte application and its AtmMpe feature (see the Attention notice below)
- the IP application and its IP feature (see the Attention notice below)

---

**Attention:** Applications WanDte (and its AtmMpe feature) and Ip (and its IP feature) are required for OAM control of CP.

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## Voice compression for VoIP

VoIP is compliant with three standards of voice compression. See the following sections for more information:

- [G.711U and G.711A voice call compression \(page 57\)](#)
- [G.729a voice call compression \(page 60\)](#)
- [G.726-32K ITU voice call compression \(page 58\)](#)
- [EVRC0 voice call compression \(page 58\)](#)

### G.711U and G.711A voice call compression

VoIP supports G.711U voice call compression with Mu-law PCM voice and G.711A which supports A-law at 64 kbit/s. The values of 64kG711 codec have been split into 64G711A and 64G711U to account for the packet log law used for the G.711 codec. When VoIP features are provisioned in the featureList, the defaultPacketLogLaw attribute must be set to useAsProfile only. Support of the G.711 voice call compression has the following considerations:

- supported for VSP2 on Nortel Multiservice Switch 7400 nodes (1008-DS0 channel capacity), and on Multiservice Switch 15000 nodes (1120-DS0 channel capacity)
- supported for VSP3 on Multiservice Switch 15000 nodes (2016-DS0 channel capacity)
- supported for VSP3-o on Multiservice Switch 15000 nodes with the following channel capacities:
  - 1953 channels for STM-1
  - 2016 channels for OC-3
- supported for 2pVSP4e FP on Multiservice Switch 15000 nodes with the following channel capacities:
  - 4032 channels for STM-1
  - 4032 channels for OC-3
  - 2016 channels when configured with vgsipRTOCdma

- supports 10 ms and 20 ms RTP packets

### **G.726-32K ITU voice call compression**

VoIP supports G.726-32K ITU voice call compression to provide functionality for lower bandwidth codecs in addition to the G.729 codec. The MG15000 supports the G726-32K ITU VoIP voice codec (10ms and 20ms) on the VSP3, VSP3-o, and 2pVSP4e FP function processors using dynamic payload types.

The MG15000 supports the G.726-32K ITU codec over IP using Session Description Protocol (SDP) within the H.248 protocol, on the VSP3 and VSP3-o, and 2pVSP4e FP. Packetization times are 10 ms and 20 ms for this codec. The default packetization time for the codec is 20 ms. The SDP parser in MG15000 supports parsing of the G726-32 ITU codec using dynamic payload types (in the range of 96-127) in conjunction with the RTPMAP SDP attribute.

---

**Attention:** The G.726-32 ITU codec is not supported for the VSP2.

---

See [Codecs and the defaultCodecList \(page 69\)](#) for more information about manipulating the defaultCodecList.

### **EVRC0 voice call compression**

The MG supports the Enhanced variable rate codec 0 (EVRC0). With the introduction of packetized voice core networks and transcoder-free operation, wireless encoded speech (encoded and decoded using EVRC0) can be carried across the voice core network in its native format. The EVRC0 codec is supported in the SDP of the H.248 protocol on VSP3-o, 2pVSP4e and 2pVS cards. EVRC0 is defined by RFC-3558 and is supported as an additional codec type.

EVRC0 is implied when the EVRC header format parameter indicates Header Free. EVRC includes the header formats (Interleave / Bundle) for encapsulation.

---

**Attention:** EVRC0 (header free format) is supported in this release. EVRC (with header format interleave/bundle) is not supported in this release.

---

The format is selected on a per-call basis according to the SDP protocol negotiated between the media gateways at each end of the call to indicate the EVRC Header Format type to use for EVRC encapsulation (In this release it is always EVRC0). The DSPs in the MG need to know how the TDM channels will operate so that EVRC encapsulation can be performed in either transcode or transcode-free operation mode.

The MG selects the RFC 3558 frame format (EVRC0) at call setup time. When RFC 3558 header free format is negotiated for TrFO support, the bearer related control information is not carried across the packet network. EVRC0 frame type information would be inferred implicitly by the RFC packet size. MG performs the appropriate mapping between the encapsulated EVRC0 packet and the RFC 3558 packet.

The MG DSP provides DTMF support with RTP carrying either RFC 2833 or G.711U traffic. RFC 2833 is the preferred choice for tone relay. For more information, see the table [DTMF with TrFO \(page 59\)](#). If RFC 2833 is negotiated and TrFO is enabled, the MG DSP enables DTMF support in the eBSC DSP. DTMF tone specifications are exchanged between the eBSC and MG DSPs in encapsulated DTMF frame formats. If RFC 2833 is not negotiated across the packet network (regardless of the TrFO setting), the MG DSP does not enable DTMF support in the eBSC DSP. DTMF tones exchanged between the eBSC and MG DSPs are in PCM format only.

#### DTMF with TrFO

<b>If</b>	<b>then</b>
RFC 2833 is negotiated and TrFO is enabled	the MG enables DTMF support in the eBSC-DSP.
RFC 2833 is not negotiated across the packet network (regardless of the TrFO setting)	the MG does not enable DTMF support in eBSC-DSP.
TrFO is not activated	encapsulated EVRC0, DTMF and DTX frames are not supported over the TDM connection.
RFC 2833 is negotiated	the MG activates DTMF tone detection upon receiving PCM traffic from the eBSC (2pVS).  The detected DTMF tone information is relayed across the packet network in RFC 2833 format. The MG also activates DTMF tone generation upon receiving RFC 2833 from the packet network. The resulting DTMF tones in PCM format are relayed to the eBSC (2pVS). MG does not support SIP via H.248 for DTMF tone specification across the packet network.
both RFC 2833 and G.711U are not supported across the packet network	the DTMF signaling is lost.

See [Codecs and the defaultCodecList \(page 69\)](#) for more information about manipulating the defaultCodecList.

### G.729a voice call compression

VoIP supports G.729a PCM voice at 64 kbit/s and CS-ACELP voice at 8 kbit/s. Support of the G.729a voice call compression has the following considerations:

- not supported for packet loss concealment (PLC)
- supports upspeeding for fax/modem, DTMF, CNG, and text telephony terminals (VSP3 only)
- supports squelch for DTMF (squelch removes DTMF signal from encoded voice path)
- supports 10 ms and 20 ms RTP packets
- supports RTP static payload types to the RFC 1890 document
- supports G.729 Annex A and B in codec selection negotiation
- supported for VSP2 on Nortel Multiservice Switch 7400 (720-DS0 channel capacity) nodes, and on Multiservice Switch 15000 nodes (800-DS0 channel capacity)
- supported for VSP3 on Multiservice Switch 15000 nodes (1512-DS0 channel capacity)
- supported for VSP3-o on Multiservice Switch 15000 nodes with the following channel capacities:
  - 1953 channels for STM-1
  - 2016 channels for OC-3
- supported for 2pVSP4e FP on Multiservice Switch 15000 nodes with the following channel capacities:
  - 4032 channels for STM-1
  - 4032 channels for OC-3
  - 2016 channels when configured with vgsipRTOCdma
- supports simultaneous transmission of DTMF tones and digit collection
- supported for H.248 version 1 protocol

When DTMF tones are detected, MG upspeeds from a G729a speed of 8 kbit/s to a G.711 speed of 64 kbit/s for the duration of the tone and then return to 8 kbit/s. DTMF tones are transferred based on the value provisioned in the digitTransport attribute of PacketNetworkProfile. When using the VSP3, VSP3-o, 2pVSP4e, or the 2pVS card, MG can transmit DTMF digits in RTP packets using the Named Telephone-Event (NTE) as described in RFC2833.

See [Codecs and the defaultCodecList \(page 69\)](#) for more information about manipulating the defaultCodecList.

## Switched IP-to-TDM gateway

A switched IP-to-TDM gateway uses MG software to provide standards-based multiplexing and demultiplexing of IP connections and all voice band services. Traffic from the narrowband network is terminated by an interworking function consisting of a voice gateway service and a media gateway controller. See [VoIP services for voice calls \(page 64\)](#). Switched MG dynamically maps time slots from a TDM network onto real-time transport protocol (RTP) flows.

From the TDM side, Nortel Multiservice Switch nodes receive TDM data through a TDM FP. The FP converts the incoming bit stream into standard 64 kbit/s channels and encapsulates them in AAL1 cells. The system then passes these cells to the VSP FP (VSP2 or VSP3) for encoding. MG identifies the cell streams as voice, fax/modem, or data calls.

An MG configuration using a VSP3-o FP card supports TDM optical connectivity through its front panel and therefore does not use the 4-port OC-3/STM-1 Ch TDM/CES FP card to supply the TDM connectivity. Even though the MG VSP3-o FP card has two optical TDM (OC-3/STM-1) interfaces, only port 0 is the active optical TDM interface for the VSP3-o. Other TDM FP cards can not be used with the VSP3-o FP card.

For Nortel Multiservice Switch 7400 VSP2, the maximum number of VPMs per VSP2 is eighteen. For Multiservice Switch 15000 VSP2, the maximum number of VPMs per VSP2 is twenty. Each VPM can support up to fifty-six time slots. For Multiservice Switch 15000 VSP3, there are twenty-one VPMs and each VPM can support up to ninety-six time slots. All VPMs are collectively assigned an IP address, which is used to carry IP traffic over a media VCC. Therefore, all media traffic to and from the VPMs originate from a single IP host, the advantage being a reduction in the number of IP addresses required compared to earlier releases. Each media connection is defined by an *IpMConn* component.

Traffic within the VSP2 or VSP3 share the same source and destination addresses and an IP packet can be routed internally to the Multiservice Switch Media Gateway.

Traffic within the VSP2, VSP3, VSP3-o, and 2pVSP4e share the same source and destination addresses and an IP packet can be routed internally to the MG.

## Signaling between the narrowband and MG for VoIP

Signaling between the narrowband network and MG is handled by an MGC. When using H.248 to make a bearer traffic connection in the MG, the MGC sends an ADD command with the appropriate parameters to the Media

Gateway. In Nortel Multiservice Switch MG, the voice services FP acts on instruction from the MGC to make or break narrowband connections between TDM trunks and RTP flows.

For more information about control connections between Multiservice Switch MG and the MGC, see [Call control for VoIP \(page 66\)](#).

## DTMF relay

VoIP functionality supports DTMF relay on Nortel Multiservice Switch 15000 nodes using the VSP3 FP, VSP3-o FP or 2pVSP4e FP cards. DTMF relay is the transport of DTMF digits from the TDM circuit over a packet network to a remote TDM circuit. DTMF relay support includes

- DTMF relay of digits 0-F via IETF document RFC 2833
- negotiation of digit relay for DTMF
- ability to enable/disable digit relay via provisioning
- dynamic payload type definition for IETF document RFC 2833
- support for transport of DTMF level parameter
- support for DTMF text telephony (ITU recommendation V.18 Annex B)

## Fax relay

VoIP functionality supports fax relay on the Nortel Multiservice Switch 15000 nodes using the VSP3, VSP3-o and 2pVSP4e FPs. Fax relay is the transport of facsimile from the TDM circuit over a packet network to a remote TDM circuit. Fax relay support includes

- support of fax relay through ITU-T recommendation T.38 via UDP/IP
- ability to enable/disable autonomous fax relay support through provisioning
- support of transferred training check frame (TCF)
- support for redundancy UDP error correction
- provisionable redundancy depth up to three secondaries of ITU-T recommendation T.38
- support for all rates of ITU-T recommendations V.17, V.27, and V.29
- fax call establishment using proprietary autonomous mode
- fax call establishment per ITU-T recommendation T.38 appendix V and Annex E
- fax relay support negotiation with remote peer
- support for IP datagrams up to 612 bytes
- new call type enumeration called faxRelay

- provisionable ability to defer ITU-T recommendation T.38 in order to support ITU-T standard V.34 over VBD mode
- support for transfer of fax calling tone CNG by either moving to VBD mode or to ITU-T recommendation T.38 mode
- support for up to 40% of simultaneous channels of ITU-T recommendation T.38
- support to scale up to 2016 simultaneous channels of ITU-T recommendation T.38
- no internally designed limit on fax capacity
- support of the MGC Transitioning Method for transitioning between Voice and T.38.
- Support of the CNG and V.21 Preamble enumerations of the 'dt' parameter of the 'dtone' observedEvent within the 'ctyp' package (described in H.248.2).

## VBD terminal support

VoIP functionality supports VBD terminals (per ITU V-series recommendations) as VBD on Nortel Multiservice Switch 15000 nodes using the VSP3 FP, VSP3-o FP, or 2pVSP4e FP cards. VBD terminal support includes

- upspeed for all non-T30 facsimile terminals
- upspeed for all modems that use V.25 calling tone and/or ANS tone
- upspeed for all modems that use V.8
- support for text telephony terminals per [Support for text telephony terminals \(page 64\)](#)
- support of only the 'dt' parameter of the 'dtone' event of the 'ctyp' package with the restriction that only the following 'dt' enumerations are supported:

For fax:

- CNG (0x0001)
- V21 Flag (0x0002)

Common to text and data:

- BellHi (0x0006)
- Baudot45 (0x0008)
- V21hi (0x000D)
- V21lo (0x000E)

- CT (0x000C) *N.B. VSP3 detects 1300 Hz which is the CT tone as well as the mark bit (Fz) of V.23 for both low and high channels.*

For modems:

- ANS (0x0012)
- ANSbar (0x0013)
- V8BIS (0x0020)

### Support for text telephony terminals

Text telephony terminals are supported in [VBD terminal support \(page 63\)](#) as follows:

- upspeed for Baudot terminals (V.18 Annex A)
- upspeed for European deaf telephone terminals (V.18 Annex C)
- upspeed for Bell 103 terminals (V.18 Annex D)
- upspeed for V.18 native mode terminals (V.18 Annex G)

### VoIP services for voice calls

Switched MG supports various services for voice calls, including

- [RTP, UDP, IP, and ICMP support \(page 64\)](#)
- [Supported packet features using VSP2 and IP functionality \(page 65\)](#)
- [Supported packet features using VSP3 and IP functionality \(page 65\)](#)
- [Supported packet features using VSP3-o or 2pVSP4e FP and IP functionality \(page 66\)](#)
- [Voice calls \(page 19\)](#)
- [Switched MG using ATM or IP services for voice calls \(page 68\)](#)

### RTP, UDP, IP, and ICMP support

MG uses real-time transport protocol (RTP) to encapsulate voice packets so they can be transported with the user datagram protocol (UDP) over IP. Multiservice Switch Media Gateway accepts RTP packets with payload types of G.711A and G.711U voice, comfort noise and named signal event (NSE). MG processes the RTP payload according to the sequence number, time stamp, and payload type. MG can support real-time conferencing protocol (RTCP) on VSP3 FP, VSP3-o FP, or 2pVSP4e FP cards.

All packets generated on a single VSP-type card have the same value of differentiated services code point (DSCP).

MG uses IP version 4 and supports provisionable differentiated services code point. MG supports 10 and 20 ms payload sizes for processing incoming IP packets.

The internet control message protocol (ICMP) is an integral part of IP that handles IP error and query messages. MG can count ICMP dest not reachable errors.

In TrFO mode, MG receives control packets over the TDM trunk, performs transadaptation, and relays traffic between the TDM and the packet interfaces. When MG receives encapsulated packets from BSC, it reformats the packets to the appropriate RTP RFC format for transmission across the packet network. It also reformats information received from the packet network to the appropriate encapsulated packets for transmission to BSC over the TDM trunk.

As well in TrFO mode, MG can temporarily switch its mode of operation according to the format and type of the uplink bearer received from the BSC. For example, in TrFO mode with DTMF support disabled, MG dynamically prepares PCM RTP when BSC transmits DTMF tones in PCM format. MG dynamically prepares RFC 3558 for EVRC0 RTP payload when an encapsulated EVRC0 packet is received again from BSC.

### **Supported packet features using VSP2 and IP functionality**

VoIP functionality and using the VSP2 FP, supports the following packet features:

- Send and receive 10 and 20 ms packets. MG only sends and receives 10 ms packets for CCD transmission.
- Detect 2100 Hz tones with and without phase reversal on the packet side and on the TDM side. The MG can determine if the 2100 Hz tone is from the packet side or from the TDM side. The packet side can have MG using IP or VoATM packets.
- Transmit RTP comfort noise (CN) packets with the payload type (PT) field in the RTP header set to the value 13 decimal. MG will receive as CN packets, all RTP packets that have a PT field in the RTP header set to either of values 13 or 19 decimal.
- Indicate a dynamic payload type in the session description protocol (SDP) in accordance with standard RFC 2327 of the Internet Engineering Task Force (IETF).

### **Supported packet features using VSP3 and IP functionality**

The VSP3 FP supports interoperability with the VSP2 in VoIP functionality. The VSP3 supports the packet features referenced in [Supported packet features using VSP2 and IP functionality \(page 65\)](#). Both VSP2 and VSP3 FPs can be used in the same shelf.

### **Supported packet features using VSP3-o or 2pVSP4e FP and IP functionality**

The VSP3-o, and 2pVSP4e FP supports interoperability with the VSP2 FP or VSP3 FP cards on Nortel Multiservice Switch 15000 for VoIP functionality. The VSP3-o and 2pVSP4e FPs support the packet features referenced in [Supported packet features using VSP2 and IP functionality \(page 65\)](#), vgsip, vgsipTrFO, and vgsipRTOCdma. Note that the EVRSCO codec only supports 20 ms packetization. The VSP2 FP, VSP3 FP, VSP3-o, or 2pVSP4e FP cards can be used in the same shelf.

### **Supported packet features using 2pVS FP and IP functionality**

The 2pVS FP supports interoperability with the VSP2 FP or VSP3 FP cards on Nortel Multiservice Switch 15000 for VoIP functionality. The 2pVS FP supports the packet features referenced in [Supported packet features using VSP2 and IP functionality \(page 65\)](#) and vgsipRTOCdma. Note that the EVRSCO codec only supports 20 ms packetization. The 2pVS, VSP2 FP, VSP3 FP, VSP3-o, or 2pVSP4e FP cards can be used in the same shelf.

## **Call control for VoIP**

The MGC is responsible for terminating the signaling received from the PSTN. The MGC uses a single control VCC to communicate to each voice services FP in MG. Each voice services FP in MG acts as an independent gateway.

When the MGC receives signaling information, it sends the appropriate commands for call establishment, release, and maintenance to the MG through its control VCC. By following these commands, the MG creates a dynamic media channel between itself and another media gateway. The control protocol for sending commands between the MGC and MG is H.248.

MG maintains a series of point-to-point connections under the direct control of the MGC. A “connection” is the association of a TDM endpoint with an RTP stream of voice packets to or from a remote transport address. A remote transport address consists of an IP address and a UDP port. The connection also includes the voice service and adaptation attributes that affect the bidirectional traffic as it flows between the two endpoints. By associating connections on two MGs connected to the IP network, the controller allows a call to be switched across the IP network.

The following sections describe the various aspects of the MGC:

- [Call setup for VoIP \(page 67\)](#)
- [IPSec for switched MG call control connections in a Carrier VoIP Network \(page 67\)](#)
- [PRI backhaul for switched MG \(page 80\)](#)
- [EN 300 V5.2 backhaul for switched MG \(page 83\)](#)

- [SS7 Backhaul for switched Media Gateway \(page 87\)](#)

### **Call setup for VoIP**

For the originating and terminating gateways to send and receive packets from the correct remote transport address, communication between the two gateways is required. Each gateway needs to know the following information:

- the remote transport address to which packets will be sent
- the acceptable encoding payload types

This information is determined through the exchange of session descriptors. The MGC sends the originating gateway's transport address and acceptable encoding payload types in an outgoing session descriptor to the terminating gateway. The MGC then sends the terminating gateway's transport address and acceptable encoding payload types back to the originating gateway in a return session descriptor.

### **IPSec for switched MG call control connections in a Carrier VoIP Network**

You have the option of activating the Internet Protocol security (IPSec) feature that provides a secure call control connection between a switched MG with VSP3-o, or 2pVSP4e FPs running VoIP and the MGC employing the H.248 call control protocol in Succession Networks.

The call control connection between a MG and a MGC (for example, Call Server 2000) controls all the calls on the gateway. Applying IPSec to a call control connection makes it secure from the potential threat of unauthorized tampering with calls. IPSec is the security mechanism for preventing unauthorized entities from accessing the control connection without the necessity of making the entire Carrier VoIP Network secure.

The IPSec application is a suite of specifications defined to provide interoperable and cryptographically-based security for IP traffic, offering different security services including

- access control
- connectionless integrity
- data origin authentication
- protection against replays
- confidentiality (encryption)
- limited traffic flow confidentiality

For more details about IPSec for switched MG, see [IPSec for switched MG call control connections in Carrier VoIP networks \(page 136\)](#).

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# Switched Media Gateway using ATM or IP functionality

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This section describes common functionality between switched Media Gateway (MG) using ATM and switched MG using IP. For more information, see the following sections:

- [Switched MG using ATM or IP services for voice calls \(page 68\)](#)
- [PRI backhaul for switched MG \(page 80\)](#)
- [EN 300 V5.2 backhaul for switched MG \(page 83\)](#)
- [SS7 Backhaul for switched Media Gateway \(page 87\)](#)
- [Custom Local Area Signaling Services \(CLASS\) \(page 92\)](#)
- [Per-Trunk Signaling \(page 93\)](#)
- [Channel Associated Signaling \(CAS\) \(page 94\)](#)
- [Switching TDM traffic in a LAPS configuration \(page 99\)](#)
- [MG carrier grade \(page 99\)](#)

For more information about switched MG functionality, see the following sections:

- [Introduction to Media Gateway 7480/15000 \(page 14\)](#)
- [Switched Media Gateway using ATM functionality \(page 41\)](#)
- [Switched Media Gateway using IP functionality \(page 50\)](#)

## Switched MG using ATM or IP services for voice calls

This section includes MG services for voice calls for both switched voice over ATM and IP. For more information about switched MG services for voice calls, see the following sections:

- [Voice calls \(page 19\)](#)
- [Switched MG using ATM services for voice calls \(page 43\)](#)
- [VoIP services for voice calls \(page 64\)](#)
- [Codecs and the defaultCodecList \(page 69\)](#)

- [Audible tones for switched MG \(page 73\)](#)
- [Dual-tone multi-frequency digit collection for switched MG \(page 77\)](#)
- [PSTN continuity testing for switched MG \(page 79\)](#)

### Codecs and the defaultCodecList

Due to the number of codecs that must be supported, Nortel has developed a mechanism that allows you to manipulate a list of default codecs for VoIP and VoATM. The mechanism uses the defaultCodecList attribute which replaces the defaultVoiceRate attribute.

The defaultCodecList attribute replaces the defaultVoiceRate attribute provisioned in previous releases such that the defaultVoiceRate concept is incorporated into the defaultCodecList as represented by the first codec in the list. The defaultCodecList attribute specifies the default codec list that the MG15000 returns when an offer SDP command that contains a choose (“\$”) is received.

---

**Attention:** The defaultCodecList is used to manipulate the order of the codecs, only. It cannot be used to delete support for a particular codec or codecs. The mechanism used to add or delete codec support is handled implicitly based on feature packaging and card type.

---

The following table defines the default settings for each defaultCodecList as packaged per feature and card type. See [Supported Codecs per Feature packaging and Card Type: \(page 70\)](#).

**Supported Codecs per Feature packaging and Card Type:**

Feature list/ cardtype	VgsIP	VgsIPGIGE	VgsIPG729 VgsIPG729GIGE	vgsAtm vgsAtmDc vgsAtmG729	VgsIPTrfo	VgsIPRtocdma
2pVSP4e <sup>5</sup> VSP3-o	64kG711A 64kG711U 32kG726ITU 8kG729	Not applicable	Not applicable	64kG711A <sup>1</sup>	64kG711A 64kG711U EVRC0	64kG711A 64kG711U 8kG729 EVRC0
2pVS	Not applicable	Not applicable	Not applicable	Not applicable <sup>2</sup>	Not applicable	64kG711A 64kG711U 8kG729 EVRC0
VSP3	64kG711A 64kG711U 32kG726ITU	64kG711A 64kG711U 32kG726ITU	64kG711A 64kG711U 32kG726ITU 8kG729	64kG711A <sup>3</sup>	Not applicable	Not applicable
VSP2	64kG711A 64kG711U	Not applicable	64kG711A 64kG711U 8kG729	64kG711A <sup>4</sup>	Not applicable	Not applicable

1. When vgsAtm is provisioned for cardTypes 2pOC3ChSmlrVsp3, the supported codecs are 64kG711A, 64kG711U, 32kG726ITU, 24kG726ITU and 8kG729. The default value of this attribute is 64kG711A.

2. vgsAtm is not supported in 2pVS cards.

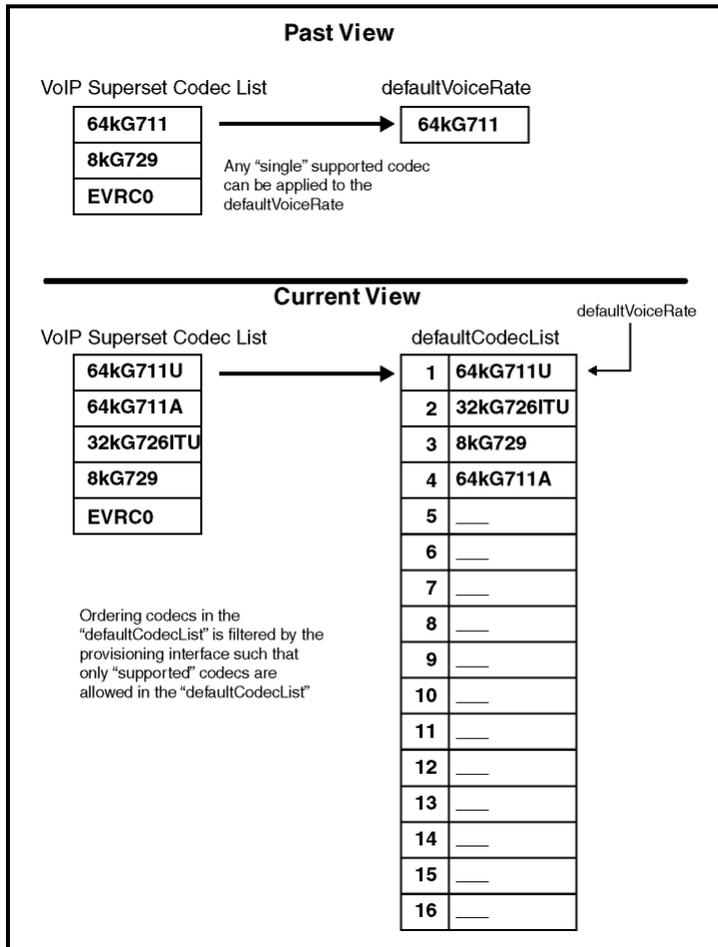
3. When vgsAtm is provisioned for cardType 2pGeMmSrVsp3, the supported codecs are 64kG711A, 64kG711U, 32kG726ITU and 24kG726ITU. When vgsAtmG729 is provisioned for cardType 2pGeMmSrVsp3, the supported codecs are 64kG711A, 64kG711U, 32kG726ITU, 24kG726ITU and 8kG729. The default value for this attribute is 64kG711A.

4. When vgsAtm is provisioned for cardType Vsp2, the supported codecs are 64kG711A, 64kG711U and 32kG726ITU. When vgsAtmG729 is provisioned for cardType Vsp2, the supported codecs are 64kG711A, 64kG711U, 32kG726ITU and 8kG729. The default value for this attribute is 64kG711A.

5. 2pVSP4e does not support ATM in this release.

A comparison of how the defaultVoiceRate was provisioned in the past and how the defaultCodeList is provisioned now using the current software is illustrated, see the figure [Provisioning the defaultVoiceRate versus defaultCodeList \(page 71\)](#).

**Provisioning the defaultVoiceRate versus defaultCodecList**



**VoATM codecs**

In VoATM scenarios the defaultCodecList acts exactly as the defaultVoiceRate.

For VoATM, the defaultCodecList can contain one value that you specify from the list of five that are supported. That is, an operator can select any single valid codec (according to the feature and card type). MG15000 supports any one of the following codecs in the defaultCodecList for VoATM:

- 64kG711A (5ms)
- 64kG711U (5ms)
- 32kG726ITU (5ms & 10ms)
- 24kG726ITU (5ms & 10ms)
- 8kG729 (10ms)

Support for the G.711 codecs is hardcoded, you can provision either one, G.711A or G.711U, over the other using the Vgs defaultPacketLogLaw, Nsta/x Vgs defaultPacketLogLaw. For VoATM solutions, the tone2100Rate attribute can be set to 64K711A, 64kG711U and G.726-32ITU.

### **VoIP codecs**

For VoIP, the order of the codecs in the defaultCodecList can be rearranged so that the MG15000 can return a list of codecs in the SDP response that is in an order that you specify with the first codec in the list providing the defaultVoiceRate. That is, for VoIP the operator can change the order of the codecs in the defaultCodecList. MG15000 supports all of the following codecs in the defaultCodecList in an order that you specify for VoIP:

- G.711U (10ms and 20ms)
- G711A (10ms and 20ms)
- G.729 (10ms and 20ms)
- G726-32 ITU (10ms and 20ms)
- EVRC0 (per RFC 3558)

The MG ignores the defaultPacketLogLaw parameter for VoIP. When you provision the defaultPacketLogLaw attribute for VoIP solutions, your selection is restricted to useAsProfile only. The provisioning system only allows the user to provision useAsProfile for the defaultPacketLogLaw in VoIP, any other setting is rejected.

You can provision codecs 64kG711U and 64kG711A as the tone2100Rate for VoIP solutions through the PacketNetworkProfile attribute (Nsta/Vgs/PktProf).

### **Migration behavior in the Codec list**

This feature fully supports hitless software migration (HSM). As part of this feature, the values of 64kG711 codec have been split up to 64G711A and 64G711U to account for the packet log law used for the G.711 codec.

The defaultCodecList is auto-populated based on the features in the Lp:

- as soon as the Lp is linked to the Nsta component when a card is initially provisioned
- during an upgrade to new software load

Upon migration, the defaultCodecList contains all supported codecs. The codecs that are presently configured on your MG change when the migration is complete, see the table [Codec list after an upgrade \(page 73\)](#):

---

**Attention:** An operator may need to re-arrange the defaultCodecList after an upgrade or install.

---

**Codec list after an upgrade**

<b>If the existing:</b>	<b>then the migration escape function will set:</b>
Vgs component contains defaultPacketLogLaw set to MuLaw and defaultVoiceRate set to 64kG711,	the attribute defaultCodecList to 64kG711U as the first codec in the new Vgs component.  In VoIP, the remaining elements of the defaultCodeclist are populated based on the featureList on that card.
Vgs component contains defaultPacketLogLaw set to ALaw and defaultVoiceRate set to 64kG711,	the attribute defaultCodecList to 64kG711A as the first codec in the new Vgs component.  In VoIP, the remaining elements of the defaultCodeclist are populated based on the featureList on that card.
Vgs component contains defaultPacketLogLaw set to MuLaw and tone2100Rate set to 64kG711,	the attribute tone2100Rate to 64kG711U in the new Vgs component
software contains VoIP packages,	the defaultPacketLogLaw to useAsProfile in the new software
Vgs component contains defaultPacketLogLaw set to ALaw and tone2100Rate set to 64kG711,	the attribute tone2100Rate to 64kG711A in the new Vgs component
Vgs component contains tone2100Rate set to 32kG726 and if the cardType is VSP3/VSP3-o/2pVS/2pVSP4e,	the attribute tone2100Rate in the new Vgs component to 32kG726ITU
Vgs component contains defaultVoiceRate set to 8kG729 or evrc0,	the attribute defaultCodecList to 8kG729, evrc0 respectively as the first codec in the new Vgs component  In VoIP, the remaining elements of the defaultCodeclist are populated based on the featureList on that card.
Vgs component contains defaultVoiceRate set to 32kG726, 24kG726, or 8kG729 in a VoATM configuration,	defaultcodeclist will be set to the single value of either 32kG726ITU, 24kG726ITU or 8kG729 respectively  There will be no change to the value of defaultPacketLogLaw.

**Audible tones for switched MG**

Nortel Multiservice Switch MG plays audible tones towards the TDM ports when the MGC instructs it to do so.

The audible tones consist of one or more tone bursts interspersed with periods of voice traffic or silence. The tone bursts are inserted into the voice traffic path to replace audio signals from the packet side of the Media Gateway. In between tone bursts, there may be periods of silence in

accordance with cadence definitions except when the voice services processor 3 (VSP3 or VSP3-o) FP or voice services processor 4e (2pVSP4e) FP card is used. When the VSP3, VSP3-o or 2pVSP4e is used, periods of either voice traffic or silence are supported between the tone bursts, in accordance with cadence definitions.

MG supports the concurrent play out of multiple tonesets. You can set a global default with the *defaultToneset* attribute of the *Nsta Vgs* component to make it easier to provision the toneset for multiple DS1 or E1 ports. The toneset for individual DS1 or E1 ports can then be provisioned separately with the *toneset* attribute of individual *Nsta Vgs Brag* components.

To play the full set of audible tones, the MGC must communicate with the Media Gateway using the H.248 control protocol.

### Supported tone packages for tones controlled by the MGC

The MGC instructs the MG to play individual tones using a specific tone identifier within a particular tone package.

The following table provides detailed information about the packages and tones that Nortel Multiservice Switch supports.

#### Supported packages and tones

Package name and identifier	Tone Identifier	Tone name
basic call progress (cg) under H.248	dt, bdt	dial
	rt, brt	(audible) ringing
basic call progress with bidirectionality (bcg) under H.248  (See information in the last row of this table.)	bt, bbt	busy
	ct, bct	congestion
	sit, bsit	special information
	wt, bwt	warning
	wt, bwt	toneburst on answer
	pt, prt, bpt, bprt	pay phone recognition
	cw, bcw	call waiting
	cr, bcr	caller waiting
(1 of 2)		

**Supported packages and tones (continued)**

Package name and identifier	Tone Identifier	Tone name
extended call progress (xcg) under H.248	cmft	comfort
	roh	off-hook warning
	nack	negative acknowledge
	vac	vacant number
	spec	special conditions dial
basic services tone generator (srvtn) under H.248	rdt	recall dial
	conf	confirmation
	ht	held
	mwt	message waiting
Alert tones (alert) under H.248	cwt	alternative call waiting tones
<p>cg/prt is the tone definition under H.248.</p> <p>Tone identifiers starting with a “b” apply to the bcg package, under H.248.</p> <p>All tone definitions in the bcg package under H.248 are the same as those in the cg package under H.248. However:</p> <ul style="list-style-type: none"> <li>• Despite the bidirectional nature of the bcg package, Media Gateway supports tones towards TDM only.</li> <li>• The bcg and cg package names are aliased.</li> <li>• MG supports aliases of bcg/bpt and bcg/bprt (same tone as cg/prt)</li> <li>• MG supports a new tone, bcg/bpy. This definition of this tone is “Do nothing. Signal completes immediately when requested”.</li> </ul>		
(2 of 2)		

MG Toneset support has been extended to include more international variants and to modify several currently supported tonesets according to the specifics of telecommunication companies within a given country toneset. On the MG7000/15000, alternative Call Waiting Tones (CWT(s)) have been introduced to meet the gateway controller (GWC) capability for alternative CWTs.

Alternate call waiting provides general support for Multiple Call Waiting Tone Patterns (up to 15) within a given country’s toneset.

It is no longer necessary to wait for the next major release to add support for a new country toneset. Up to 5 new country tonesets per release can be supported through a patch.

The toneburst-on-answer tone replaces the warning tone for the following countries: Belgium, France, Italy, Ireland, Netherlands, Spain, and the UK.

The VSP2, VSP3-o and 2pVSP4e FP cards can play up to three simultaneous monotones, whereas the VSP3 FP card can play up to four. Some tones use four simultaneous monotones, such as the off-hook warning tone for some countries. In this case, the definitions of those tones are slightly different, depending on which type of voice services processor card is used.

---

**Attention:** The VSP3-o and 2pVSP4e FP card support tones to the TDM side of the MG and does not support tones for the packet side of the MG.

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Tone power level definitions are with respect to an egress gain of 0 dB. Any non-zero setting of egress gain accordingly affects the output power level of the tones.

For the tone definitions for each country that MG supports, see [Definitions of audible tones by country \(page 183\)](#).

### **Behavior of tones controlled by the MGC**

The MGC activates a tone by requesting its specific mnemonic in a SIGNAL REQUEST message to the MG. The MG plays the tone, immediately pre-empting any existing play out.

MG can play any tone on any endpoint regardless of the tones or services being played on any other endpoint.

Tones are played continuously (aside from cadencing) regardless of

- the state of any connection or mode of a connection associated with the endpoint
- any changes to the state of any connection or mode of a connection associated with the endpoint

Endpoints that are in loop back mode are an exception to this rule. These endpoints have the loop back asserted rather than the tone. When loop back is removed, the tone is re-asserted.

A tones plays until one of the following conditions is met:

- The timer (if applicable) expires.

- The MG receives a SIGNAL REQUEST message without a specific mnemonic.
- The control protocol is H.248 version 1 and an appropriate event occurs as requested by a REQUESTED EVENT message. For example, if dialed digits are requested for notification at the same time tone play out is requested, the dial tone ceases when the first DTMF digit is detected.

The MG rejects SIGNAL REQUEST messages that ask for

- simultaneous play out of more than one tone on the same endpoint
- concatenated play out of more than one tone on the same endpoint

At any time, you can re-provision the toneset used. For example, if you re-provision the toneset from Portugal to Spain, the following is the resulting behavior:

- For tones in progress during re-provisioning, the MG continues to play out those tones from the Portuguese toneset.
- For new SIGNAL REQUEST messages, the MG plays out tones from the Spanish toneset.

Tone packages are supported in their entirety. The MG always acknowledges valid requests for tones within packages that it supports.

Where the combination of tone identity and toneset identity is undefined, MG plays no tone. When the tone package is unknown or the tone identity within the package is unrecognized, MG returns an appropriate error code.

The MGC instructs the MG to notify the MGC when the tone or toneset ceases because of a time-out or a failure. If no tone is played, the notification (if requested) is sent immediately after the request is acknowledged.

### **Dual-tone multi-frequency digit collection for switched MG**

MG can collect and report digits on the TDM circuit side, under MGC control. MG collects DTMF digit strings up to 32 digits in length, including the digits \*, #, 0–9, and A-D. As well, Media Gateway can detect the difference between short and long \* and # digits.

DTMF digit generation via use of the H.248 'dg' package and the capability to set the duration of the digits by the MGC, allows the MG to be interoperable with H.323 GWs.

---

**Attention:** To use MG to collect and report digits, the MGC must use the H.248 version 1 protocol to communicate with the MG.

---

For more information about digit collection, see

- [Types of digit collection \(page 78\)](#)
- [Digit collection timers \(page 78\)](#)
- [Digit collection statistics \(page 79\)](#)
- [Digit collection buffer \(page 79\)](#)

### **Types of digit collection**

MG is capable of three types of digit collection:

- digit collection with digit maps
- digit collection without digit maps
- mid-call digit collection

During digit collection with digit maps, the MG collects dialed digits using any digit map or digit map combinations transmitted or supported by H.248 version 1 control protocol. The length of the digit map is limited to 400 characters.

MG supports digit collection without digit maps by collecting individual digits. Single digits are collected using H.248: Notify Immediately action code.

During mid-call digit collection, the MGC arms the MG digit buffer with the mid-call digit pattern. If that pattern is detected during the call, the MGC is informed. The MGC is only notified if the exact character string is matched. Mid-call triggers are frequently used for call re-origination. In North America, the re-origination tone is achieved by holding the # digit for the duration specified by the *longDigitTimerDuration* attribute. For more information about digit timers, see [Digit collection timers \(page 78\)](#).

### **Digit collection timers**

MG uses the provisionable timer attributes of the *Vgs DigitCollection* component to control digit collection. The timers use default values unless a value is supplied by the MGC. When the timers expire, a NOTIFICATION message is sent to the MGC.

The *initialDigitTimer* attribute controls the maximum length of time allowable between the digit collection request and the entering of the first digit. The *shortInterDigitTimer* and *longInterDigitTimer* attributes, when activated, control the length of time between each key press. The timer is reset after each key press is received by the MG. The MGC REQUEST message determines if and when these timers are applied to digit collection.

The *longDigitTimerDuration* attribute specifies the length of time the \* or # digits must be pressed to be recognized as a long digit.

### **Digit collection statistics**

Digit collection statistics are collected with the *collectionsInProgress* and *peakCollectionsInProgress* operational attributes of the *Vgs DigitCollection* component.

The *collectionsInProgress* attribute tracks the percentage proportion of digit collection resources that are currently being used. This value excludes endpoints that are collecting mid-call triggers.

The *peakCollectionsInProgress* attribute tracks the percentage proportion of digit collection resources that have been used at any point since the last reset of the attribute. This value excludes endpoints that have been requested to collect mid-call triggers.

The *rejectedCollectionRequests* attribute counts the number of digit collection requests that are rejected due to lack of resources. On overflow this counter starts at zero again. If the *pmodule fails*, the count is reset. Persistent increase of this statistic indicates an engineering mismatch between demand and capacity of the digit collection resources. MG can allocate 120 resources per VSP2 FP card, 200 resources per VSP3 FP card, 2016 resources per VSP3-o FP card, and 4032 resources per 2pVSP4e FP card to simultaneous digit collection, excluding mid-call trigger. Mid-call trigger may be enabled on 100% of endpoints.

The Zero verb can be used to re-initialize the *peakCollectionsInProgress* operational attribute. For more information, see *Nortel Media Gateway 7480/15000 Switched Service Configuration Management (NN10600-782)*.

### **Digit collection buffer**

Collected digits are placed in a digit buffer. The digit buffer has finite capacity, and once full, it discards digits until the buffer is reduced or cleared. The digit buffer is cleared when

- an explicit notification request against the specific endpoint is received without digits as requested events
- a maintenance action is taken to free accumulated resources
- an explicit flush request is received as part of a new request
- a mismatch or time-out occurs in a mid-call trigger

### **PSTN continuity testing for switched MG**

MG supports both terminating and originating 4-wire continuity testing to the PSTN network.

Terminating 4-wire continuity testing is supported through the loop back response signal.

In originating 4-wire continuity testing, the MGC requests the MG to send a continuous 2010 Hz tone towards the TDM ports and search for the same tone as a response. During this process, echo cancellation is disabled if it appears in the continuity path. The return tone is not transmitted towards the packet network regardless of mode. Instead, silence or comfort noise is played out if the endpoint is in Send mode.

The MG assumes that the MGC contains the continuity timer. The MG plays the continuity tone until requested to stop by the MGC or until the return tone is detected.

---

**Attention:** For the VSP3, VSP3-oand 2pVSP4e FP cards, continuity testing only arms the tone detectors when a continuity test has been requested by the MGC. During normal call operation, the echo canceller does not become disabled when 1780 Hz and 2010 Hz tones are detected.

---

MG rejects any request from the MGC to

- perform a continuity check while playing another tone on the same endpoint
- concatenate the play out of a tone with a continuity test on the same endpoint

The specifications and tolerances of the continuity tone are located in

- Annex B1.2 of ANSI document T1.113.4, *ISDN User Part 1995*
- Section 7.1 and 7.2 of ITU-T Recommendation Q.724, *SS7 Signaling Procedures*

## **PRI backhaul for switched MG**

MG can serve as a signaling gateway (SG) for primary rate interface (PRI) backhaul. In PRI backhaul, the MG serves as an SG to transport ISDN PRI signaling between a PRI-controlled device and an MGC. PRI backhaul is defined as the termination at the SG of the lower layers of the signaling stack for a switched circuit network and the transport (or backhaul) to the MGC of the higher layers of the same signaling stack. The PRI D-channel signaling of PRI backhaul through the MG, is for call control and not for connection control. PRI-controlled devices are private branch exchanges (PBX), remote access servers (RAS), local area networks (LAN), and host computers to the networks.

MG has two links to transport PRI D-channel signaling as follows:

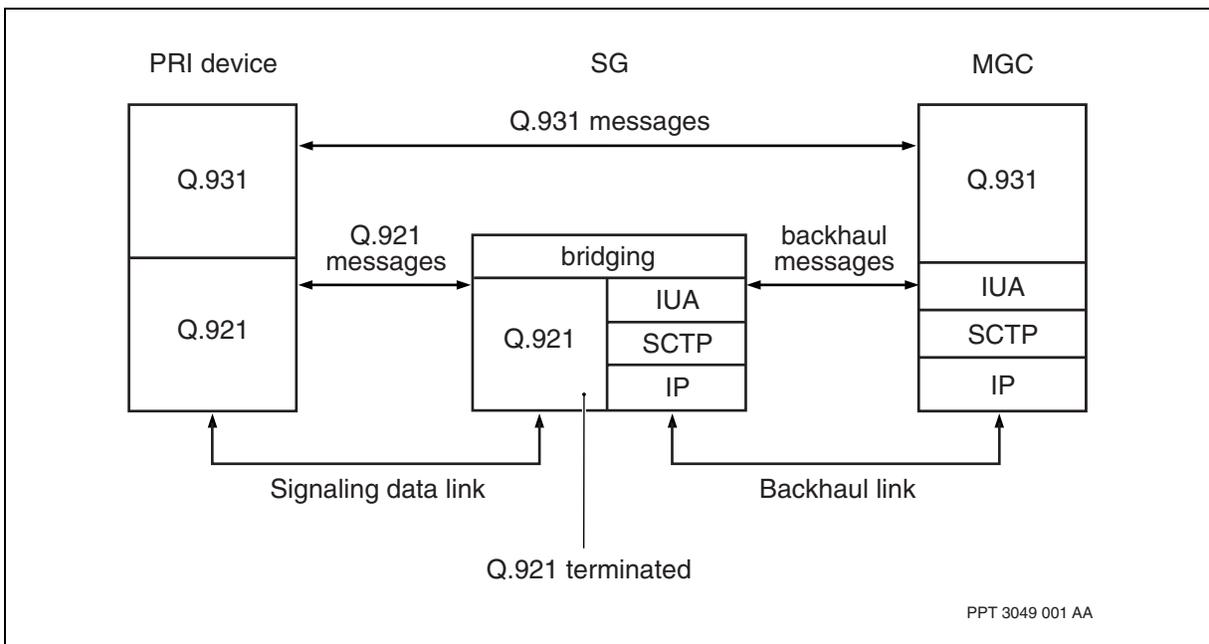
- a signaling datalink between the MG and PRI-controlled device
- a backhaul link between the MG and the MGC

PRI backhaul uses an interworking protocol called ISDN Q.921 user adaptation layer protocol (IUA)/stream control transmission protocol (SCTP). PRI D-channel signaling is transported between the Media Gateway and the PRI-controlled trunks using protocol of Q.931 encapsulated in Q.921 over the signaling datalinks. MG terminates Q.921 messages from the PRI-controlled trunks. The IUA/SCTP protocol is used to transport Q.931 signaling messages between MG and the MGC over the backhaul links.

MG can be configured to be the network end or the user end of the PRI trunk. The default configuration is for the MG to be the network end.

The protocol layers for control messages of PRI backhaul are shown in [Protocol layers for control messages of PRI backhaul \(page 81\)](#).

**Protocol layers for control messages of PRI backhaul**



PRI backhaul enables the MG to act as an integrated services hub (ISH) handling both call control and connection control messages. The ISH is divided into two logical parts as follows:

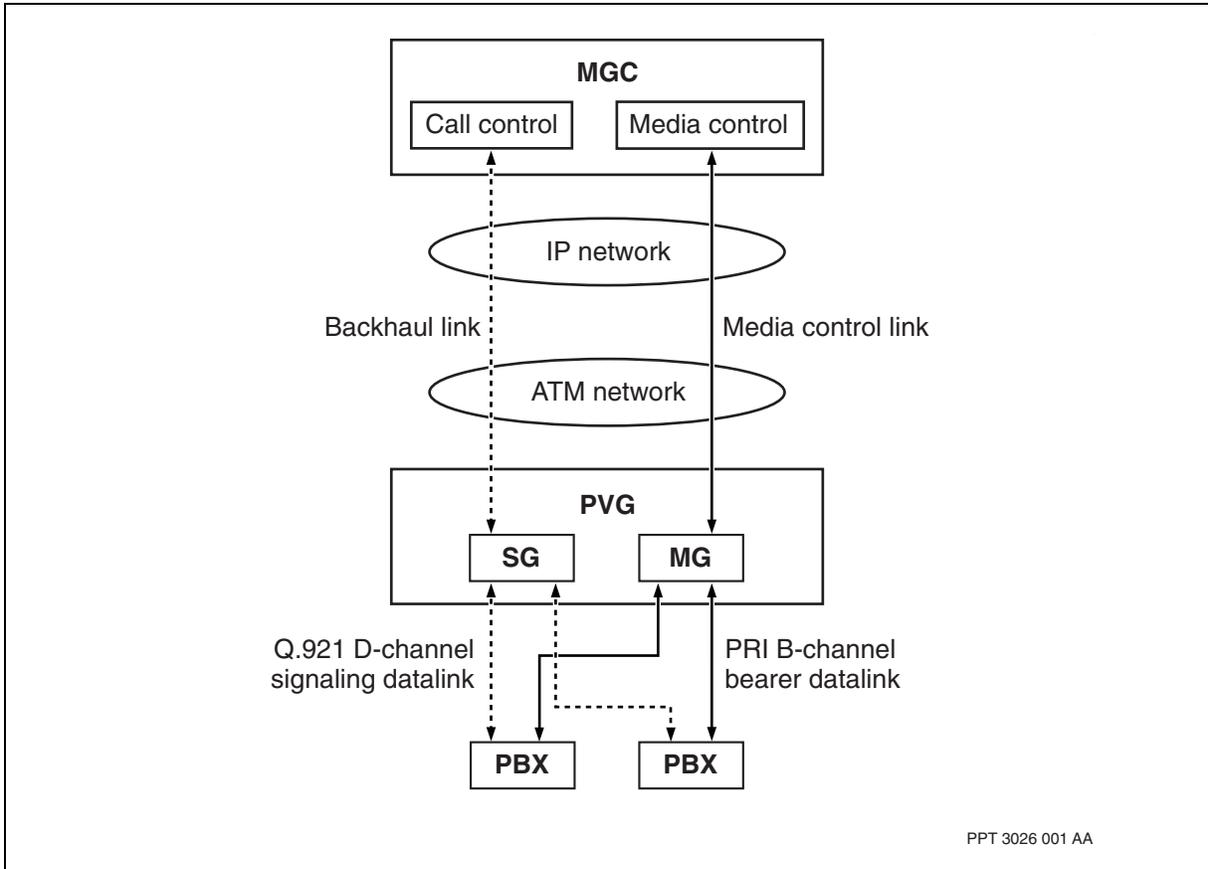
- the signaling gateway (SG) part
- the media gateway (MG) part

The SG part uses IUA/SCTP/IP to backhaul call control messages between the PRI-controlled device and the MGC (IUA is ISDN Q.921 user adaptation layer; SCTP is stream control transmission protocol; IP is internet protocol).

The MG part uses H.248 protocol, UDP, and IP to transport connection control messages between the MGC and the MG (UDP is user datagram protocol; IP is internet protocol).

The SG and MG logical parts of the ISH are shown in [Architecture diagram of PRI backhaul for MG \(page 82\)](#). For more information on the MG, refer to [MGC connections for switched MG using ATM \(page 48\)](#).

### Architecture diagram of PRI backhaul for MG



PRI backhaul for MG requires the following:

- VSP2, VSP3, VSP3-o, or 2pVSP4eFP
- SG sparing by VSP2, VSP3, VSP3-o, or 2pVSP4e FP sparing using cold standby for unrecoverable failures
- one D-channel maximum per T1/E1 carrier facility
- each SG entity of MG can be controlled by only one MGC at a time (each VSP2, VSP3, VSP3-o, or 2pVSP4e FP card can contain one SG entity)

## EN 300 V5.2 backhaul for switched MG

MG can serve as a SG to backhaul signaling information from interfaces conforming to the V5.2 specification as laid out in the ETSI EN 300 324-1 and EN 300 347-1 standards. These interfaces are called *V5.2 interfaces* in this document.

A V5.2 interface connects a local exchange in the PSTN network to a number of remote end users. The remote end users are connected through a hub forming an access network. The V5.2 interface connects the hub to the PSTN network. The V5.2 interface supports up to 16 E1 links, where each link can contain bearer channels (B-channels) and signaling channels (C-channels). The V5.2 interface supports several signaling protocols, including

- PSTN analog
- other analog and digital accesses, both semi-permanent and permanent

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**Attention:** Although the V5.2 specification supports ETSI BRI and PRI, the current version of V5.2 backhaul for switched MG does not.

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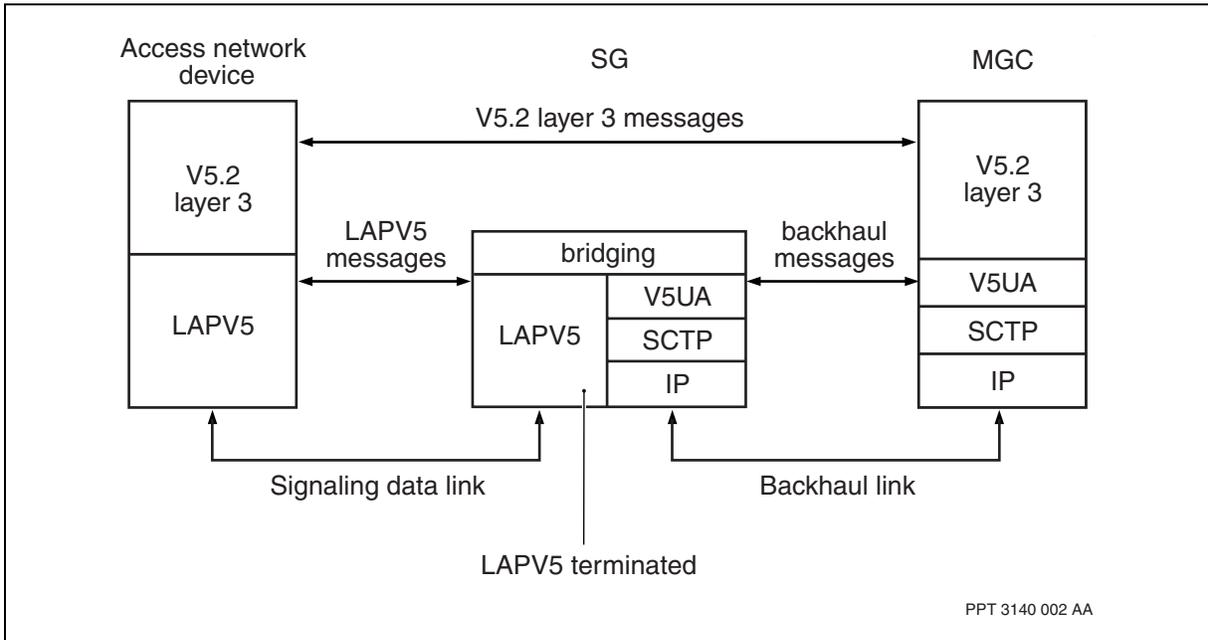
In V5.2 backhaul, the MG serves as an SG to transport V5.2 signaling between an access network device and an MGC. V5.2 backhaul is defined as the termination at the SG of the lower layers of the signaling stack for a switched circuit network and the transport (or backhaul) to the MGC of the higher layers of the same signaling stack. The protocol layers for control messages of V5.2 backhaul are shown in [Protocol layers for control messages of V5.2 backhaul \(page 84\)](#).

MG has two links to transport V5.2 layer 3 signaling messages as follows:

- a signaling datalink between the MG and access network device
- a backhaul link between the MG and the MGC

V5.2 backhaul uses an interworking protocol called V5.2 user adaptation layer protocol (V5UA)/SCTP. V5.2 channel signaling is transported between the MG and the access network device using LAPV5 messages. LAPV5 messages consists of LAPV5-DL packets encapsulated in LAPV5-EF packets over the signaling datalinks. The MG terminates V5.2 layer 2 messages from the access network device. The V5UA/SCTP protocol is used to transport V5.2 layer 3 messages between the MG and the MGC over the backhaul links.

**Protocol layers for control messages of V5.2 backhaul**



V5.2 backhaul enables the MG to be divided into two logical parts as follows:

- the SG part, that transport signaling data and provides connection control
- the MG part, that transport bearer traffic

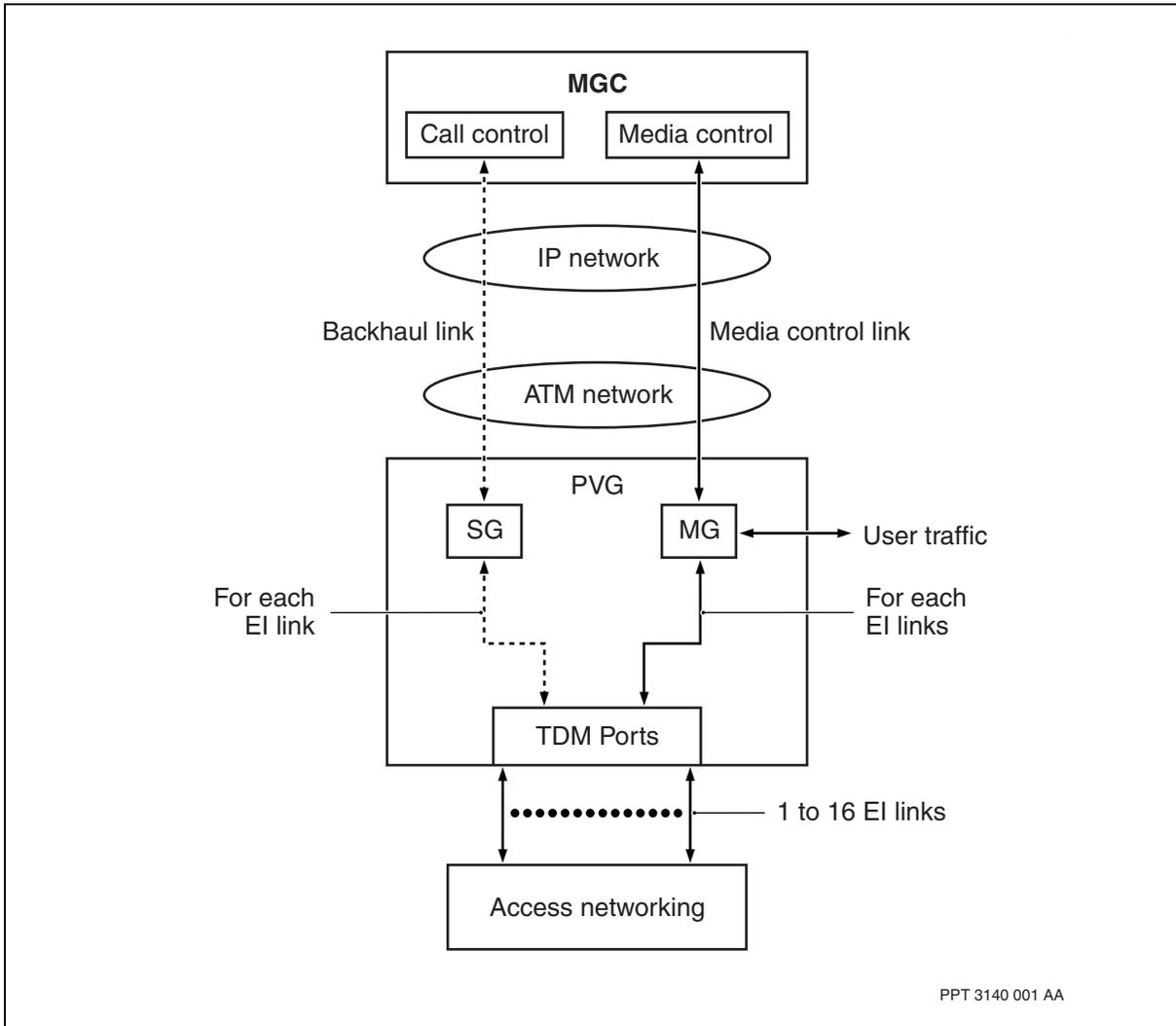
The SG part uses V5UA/SCTP/IP to backhaul the following types of messages between the access network device and the MGC:

- maintenance messages and link identification messages for each E1 link
- call control messages for each E1 link that has active C-channels

The MG part uses H.248, UDP, and IP to transport connection control messages between the MGC and the MG.

The SG and MG logical parts of the MG are shown in [Architecture diagram of V5.2 backhaul for switched MG \(page 85\)](#). For more information of the MG, refer to [MGC connections for switched MG using ATM \(page 48\)](#).

**Architecture diagram of V5.2 backhaul for switched MG**



V5.2 backhaul for switched MG requires the following:

- VSP2 or VSP3
- SG sparing by VSP2 or VSP3 sparing using cold standby for unrecoverable failures
- each SG entity of MG can be controlled by only one MGC at a time (each VSP2 or VSP3 card can contain one SG entity)

As well, V5.2 backhaul cannot be performed with the 4-port OC-3/STM-1Ch TDM/CES FP.

For additional information, see [V5.2 backhaul for switched MG \(page 86\)](#).

## V5.2 backhaul for switched MG

A single V5.2 interface can be implemented across one or more VSP-type cards. When more than one VSP-type card is used, they can be located on the same or on different MG equipment racks. In addition, a single VSP-type card can support more than one V5.2 interface.

Each VSP-type card implements the SG function to handle the C-channel signaling transport as well as the MG function to handle B-channel transport. Each SG has separate SCTP associations to each of the controlling MGCs. A single SCTP association can carry the C-channels of several V5.2 interfaces in different streams. There is an SG on every VSP-type card involved in V5.2 processing, whether there are any C-channels configured on the links handled by the VSP-type card or not.

Splitting the V5.2 interface across many VSP-type cards and MGs provides protection against single point failures.

## V5.2 for VSP3-o

The VSP3-o FP supports V5.2 Backhaul differently than on the VSP2 and VSP3 FPs. The provisioning of V5UA over SCTP is different on the VSP3-o but the actual service is the same (V5UA over SCTP). TDM components with a different hierarchy have been developed to align with existing components that reside on the VSP3-o FP. The existing TDM components still function but they only apply to the VSP2 and VSP3 FPs.

The VSP3-o FP allows you to use the optical TDM port in place of the electrical connections to the 32 port E1 FP used for the VSP2 and VSP3 FPs. You can use up to 84 c-channels spread across the 63 available E1 links that are terminated on the VSP3-o FP.

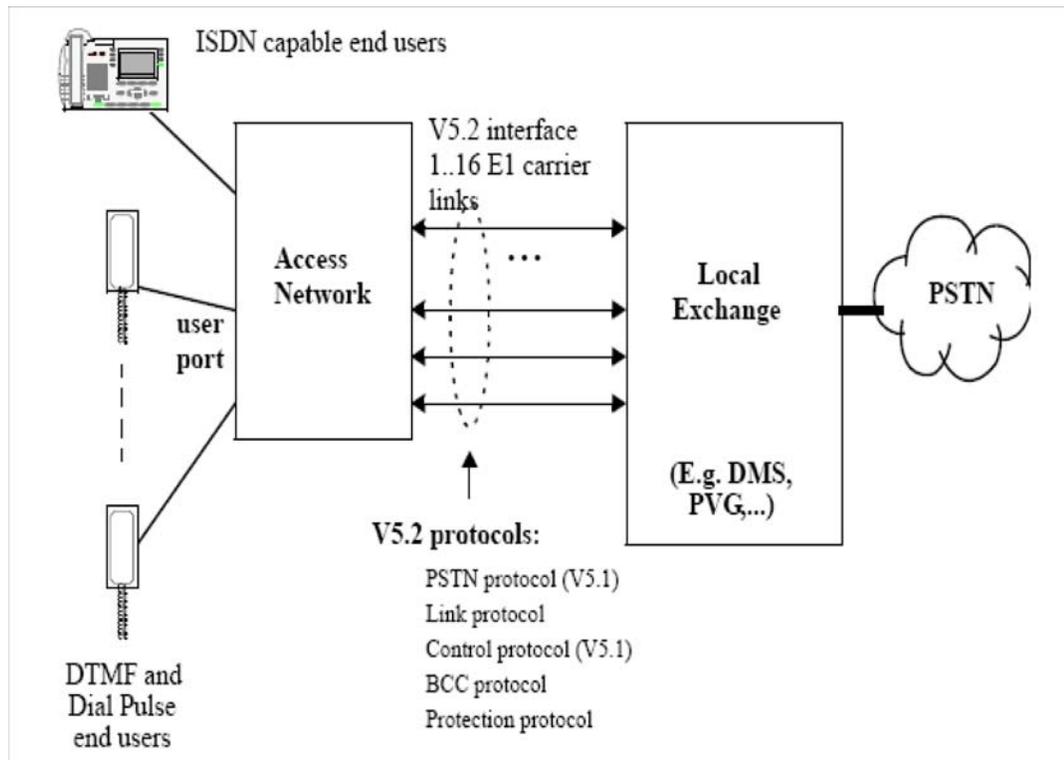
V5.2 support on VSP3-o is on a STM1 interface and is functionally equivalent to V5.2 protocol support on VSP3. Up to 1890 V5.2 interface ports are supported on the VSP3-o STM1 interface. The V5.2 interface supports an open interface between the switched network and access network. Interfaces complying to this protocol use bearer (B) channels and signalling channels (C) channels. They provide the following features:

- inter-operability between vendor equipment
- concentration of access channels (typically, 8:1, with 8 end user terminals per bearer channel)
- robustness because of backup C-channels
- support for connection of an Access Network to a Local Exchange
- support for signalling of several protocols over the same interface as follows:
  - PSTN analogue

- other analog and digital accesses; semi permanent and permanent
- up to 16 x 2.048 kbits/s PCM-30 (E1) links

V5.2 concept illustration helps explain V5.2.

### V5.2 concept



The layer 1, 2, and 3 aspects of the V5.2 interface are defined in two parts: the V5.1 protocol and the V5.2 protocol.

The V5.1 protocol is based on a single 2048 kbps physical link (E1) and does not support concentration of information links on a physical channel.

The V5.2 protocol is an enhancement of V5.1 that supports concentration using a dedicated protocol known as the Bearer Channel Connection (BCC) Protocol.

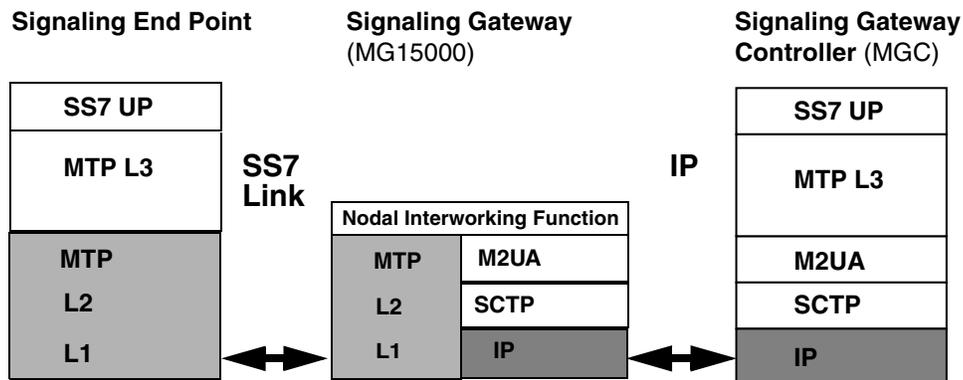
The V5.2 interfaces support up to sixteen 2048 kbps links.

## SS7 Backhaul for switched Media Gateway

SS7 Backhaul provides support for CCS7 signaling backhaul over IP via the MG15000 to enable the transport of channelized SS7 signaling between a Signaling Endpoint (SEP) and MGC. The Media Gateway 15000 acts as a

signaling gateway (SG) that transports the signaling between the SEP and the signaling gateway controller (SGC) (otherwise referred to as an MGC). See how the MG15000 facilitates transport in the figure [MG15000 transport mechanism \(page 88\)](#).

### MG15000 transport mechanism



### SS7 backhaul data flow

The MG15000 terminates and processes MTP level 2 (Q.703) messages. All upper layer protocol messages pass through the MG seamlessly. The data contained in the message is not processed or validated in anyway.

M2UA layer management messages received on the MG15000 from either the operator or the MGC may cause Q.703 messages to originate from the MG towards the TDM device. The appropriate response is sent back to the MGC for any request that the MGC makes.

The MGC is represented in the MG15000 as an Application server process component (ASP). The IP address of each ASP is provisioned within this component along with the interface identifiers (IIDs) which represent the SS7 links that the ASP controls.

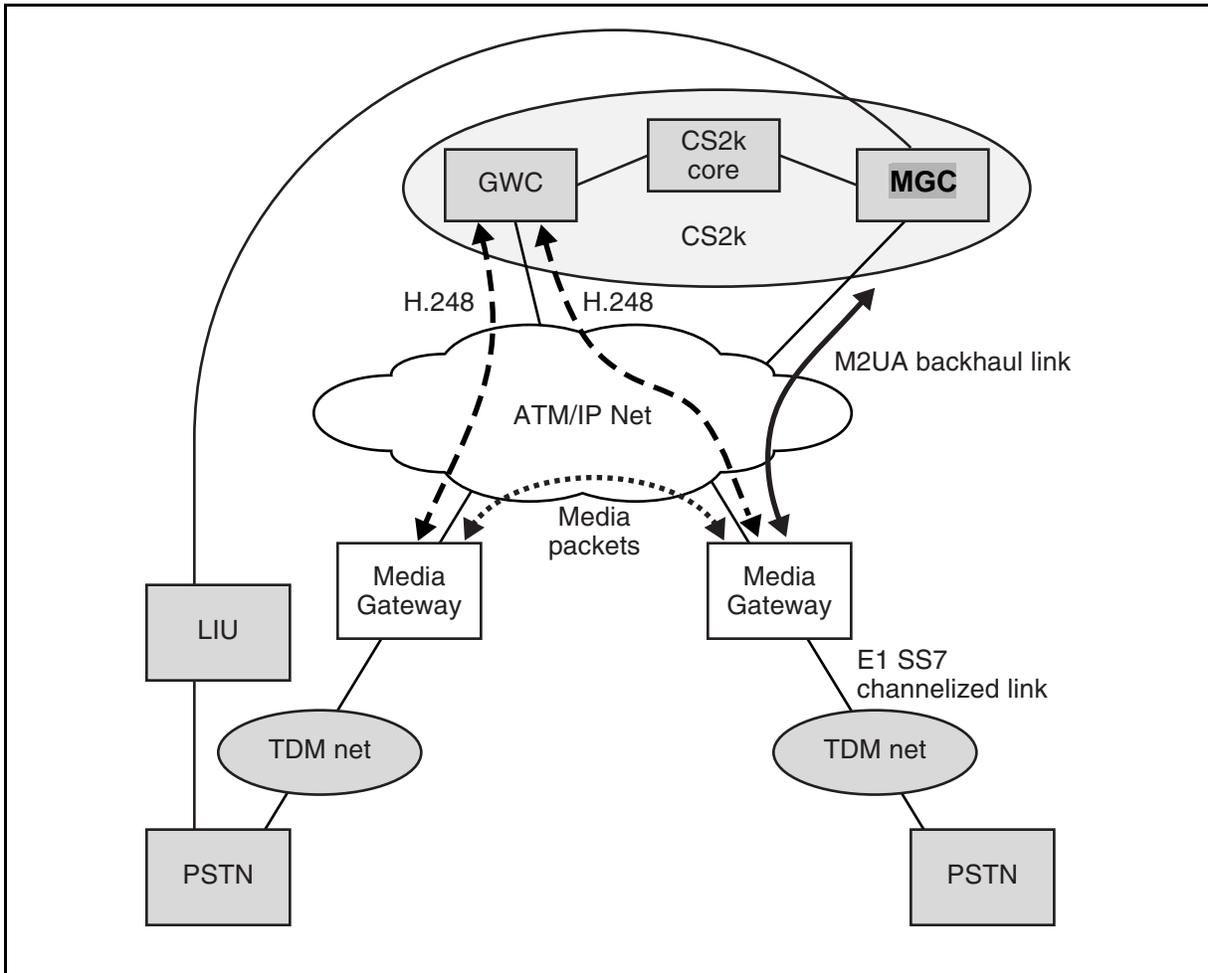
Each MGC establishes a SCTP link layer (association) to the signaling gateway (SG). Each SS7 link is carried in a separate SCTP stream from the SG. The SG does not prohibit incoming data from being managed in separate SCTP streams or in a combined single SCTP stream.

### SS7 backhaul work flow

SS7 Backhaul terminates ETSI - SS7 channelized access links on the MG15000 at the Message Transfer Part 2 (MTP2) layer and transports (or backhauls) the upper layer protocols over IETF signaling transport specifications (M2UA and SCTP) to an MGC. The link between the SG and the SEP is termed the signaling data link. The link between the SG and the

MGC is termed the backhaul link. The SG uses the M2UA and SCTP specifications to send the upper layer messages across the backhaul link. See the figure [Typical configuration for SS7 backhaul \(page 89\)](#).

**Typical configuration for SS7 backhaul**



The link between MG and the TDM network uses an E1 SS7 channelized link. Interface identifiers (IIDs) are used between the SG and the SGC to manage the different links. The static allocation of IIDs to the Application server process (ASP) component means that the Link Key Management procedures are not required. The IID is an integer identifier and is a provisionable attribute which is linked to a physical port in CDL. The SG uses this mapping to ensure the proper routing of messages between the SEP and the MGC.

SS7 backhaul allows the SS7 signaling links that are embedded with the bearer traffic to be terminated at the point of interconnect without them having to be extracted from the bearer traffic and routed separately to the MGC. This solution removes the need to provide and maintain a separate architecture to

transport these signaling links and replaces the use of associated or quasi-associated CCS7 interconnects, where the signalling links are embedded with the bearer traffic at the point of interconnect.

### Supported configurations

SS7 backhaul is supported for the IP, IP/ATM, and VoAAL2 solutions on the VSP3-o, and 2pVSP4e card and allows the operation of single or multiple signaling channels on any timeslot within the E1. Up to 63 SS7 channelized access links, or the maximum number of E1 links on the STM-1 interface that is terminated by the VSP3-o, and 2pVSP4e card are supported. This feature supports Hitless software migration (HSM) and Hitless equipment protection (HEP) but experiences an outage whenever the VSP FP switches over.

SS7 backhaul can co-exist with the PRI Backhaul functionality that is supported on the VSP3-o, and 2pVSP4e card. However, they do not interact. The signaling channels are divided between the PRI and SS7 backhaul applications such that a signaling channel carries either PRI/Q.921 signaling or SS7/MTP2 signaling traffic. SS7 Backhaul and PRI Backhaul run independently but share the same SCTP software and HDLC termination device. The SCTP associations are managed based on the assigned SCTP port numbers.

A maximum of 16 ASPs are supported with a maximum of eight links per ASP. Media and signaling channels are supported concurrently with no impact to total channel density (Media + signaling channels = 1953 DS0). SS7 signaling links can support up to 0.8 Erlang which is supported over redundant lines - 0.4 Erlang on each line. That is, the SS7 signaling links are spread over two active VSP3-o cards. For a maximum traffic load of 0.8 Erlang, each signaling link is engineered with 0.4 Erlang for normal operation. If one link goes down, SS7 traffic is re-routed to the remaining link which would be required to support the full 0.8 Erlang of traffic. SS7 signaling link redundancy is supported using a minimum of two VSP3-o, and 2pVSP4e cards. See [Signaling links over two VSP3-o cards \(page 91\)](#).

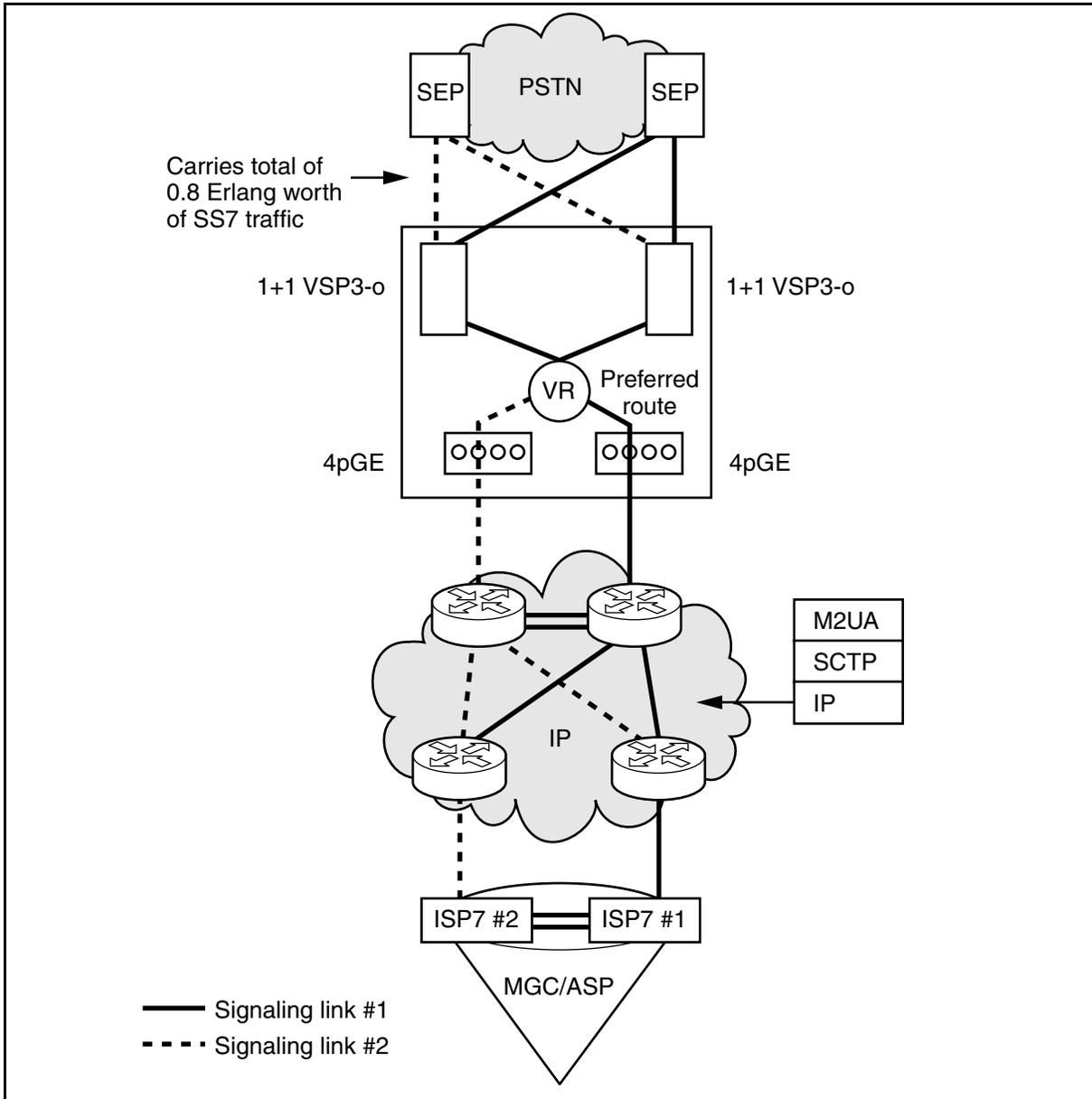
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**Attention:** The MG does not support 63 E1 links with each link processing 0.4 Erlang. Each VSP3-o, and 2pVSP4e card supports a maximum of eight M2UA IID links between the SG and the Application Server Process (ASP) of the Application Server (AS) component. A maximum of 63 timeslots are allowed for MTP2 signaling on each VSP3-o and 2pVSP4e card, however, only one MTP2 component can be linked to a single Chan component. It is recommended that the signaling links in a link set are placed on different MG shelves. The aggregated SS7 traffic on the provisioned links cannot exceed the card limitation.

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Signaling links are configured via the MTP2 component (under Nsta Vgs). Each MTP2 component represents the association between a TDM timeslot used for SS7 signaling and a processing profile. Multiple SS7 signaling links can be configured on one E1 and all the timeslots on a single E1 can be used as SS7 signaling links. Multiple MTP2 signaling channels within the same E1 must be linked to separate *Chan* components and the *Chan* component used by MTP2 must contain only one timeslot (in the timeslots attribute).

### Signaling links over two VSP3-o cards



## SS7 backhaul supported standards

The following standards are used for SS7 Backhaul:

- ITU-T Q.702 Signalling Data Link  
This specification is used on the MG15000 to terminate messages from the SEP. Only E1 termination is supported with a supported bit rate of 64 kbps. Also note that there is no bit inversion performed.
- ITU-T Q.703 Signalling Link  
This specification is used on the MG15000 to establish and maintain a signaling link that is used to terminate/originate MTP level 2 messages.
- RFC 3331 - Signaling System 7 (SS7) Message Transfer Part 2 (MTP2) - User Adaptation Layer (M2UA)  
This specification provides the backhaul interface between a signaling gateway (SG) and a signaling gateway controller (SGC) or MGC. This allows the signaling gateway to terminate the MTP level 2 messages and transport the MTP level 3 messages over IP to a signaling gateway controller.
- RFC 2960 - Stream Control Transmission Protocol  
This specification provides a layer for reliable data transfer of PSTN signaling messages across a connectionless packet network (for example, an IP network). Associations are initialized and maintained between the SCTP layers on the SG and the SGC. The MG15000 supports version 11 of the SCTP Implementer's guide. The SCTP layer uses a 32 bit CRC checksum as outlined in RFC 3309 - Stream Control Transmission Protocol (SCTP) Checksum Change.

## Custom Local Area Signaling Services (CLASS)

Custom Local Area Signaling Services (CLASS) adds functionality to the switched mode Media Gateway on V5.2 to allow the generation of Terminal Equipment (TE) display/indicator information (for example, calling line identity) on TDM trunks.

For a traditional V5.2 configuration, CLASS functions are normally performed by the Local Exchange (LE). For voice over packet configurations, the LE is replaced with the Media Gateway (MG) and Media Gateway Controller (MGC). The media path CLASS functionality is performed by the MG when commanded by the MGC.

The following features are supported:

- VSP2 (PP7000 and PP15000) and VSP3 support
- VSP3-o, and 2pVSP4e support only the 'dg' package

- V.23 Frequency Shift Keyed (FSK) TE display/indicator procedures as per the European Telecommunications Standards Institute (ETSI) specifications, except for those functions that can only be achieved by line gateways
- Japan Calling Number Display FSK procedure
- FSK payload data up to 80 octets
- Generation of DTMF digit sequences as per ETSI specifications
- DTMF digit sequence generation up to 32 digits, with a default digit duration of 70 ms (which can be modified by the MGC via the signal duration parameter), and interdigit duration of 70 ms (which cannot be modified by the MGC). This only applies to the 'dg' package.
- Support for VoIP and VoAAL2
- Support for the 32-port E1 TDM FP card only
- Support for "burst" call waiting tones that are short in duration.
- CLASS functionality controlled using H.248
  - The parts of the "alert" and "andisp" packages applicable to non-line gateways
  - Sequential signal lists for the generation of DTMF digit sequences
  - The DTMF tones defined in the "dg" package

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**Attention:** The VSP3-o and 2pVSP4e FP cards do not support CLASS.

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The CLASS functionality is always enabled for the software load, but can be disabled at the MGC.

## Per-Trunk Signaling

Per-Trunk Signaling (PTS) is supported on VPS3-o and 2pVSP4e using the concept of CAS Profiles. The profile contains the line and register signaling details that are particular to a certain variant of CAS signaling, such as values of particular ABCD bits mapping to certain generic CAS states, timings, and tolerances. The profiles do not completely define the CAS protocol, only those behaviors locally performed by the gateway.

Incoming signals on the TDM interface are extracted from their CAS variant waveform according to the profile associated with each TDM endpoint and they are backhauled to the MGC using H.248. In reverse direction, incoming CAS signals from the MGC are applied to the designated TDM endpoints following the description indicated in the associated profile.

MG supports MF R1, DTMF, and Dial Pulse register signaling.

PTS trunks are supported on both DS1 and E1 interfaces, but not simultaneously. A VSP3-o, or 2pVSP4e can support any mix of PTS, PRI, and ISUP trunks as limited by the DS1/E1 granularity.

VSP3-o supports up to 2016 CAS PTS DS0s for DS1 (for DS1/OC3).

2pVSP4e supports up to 4032 CAS PTS DS0s for DS1 (for DS1/OC3), however, there is a CVoIP Gateway Controller (GWC) limitation of 1008 PTS/CAS trunks per Gateway.

VSP3-o supports up to 1890 CAS PTS DS0s for E1 (for E1/STM1).

MG supports the following North American PTS trunks in conjunction with CS2K:

- ATC
- CELL
- DAL
- EANT
- ES
- IBN (basic calls: TI/TO/T2)
- IT
- ONAT
- OP
- PX
- Supercama

---

**Attention:** NullE1 is available for E1 CAS multiframe physical signaling. This profile does not provide a valid CAS signaling variant but is only provided to allow E1 CAS multiframed physical signaling for systems where it is necessary but which do not require any support (detection or setting) for the ABCD signaling bits. If the nullE1 profile is used, incoming signaling bits are ignored and outgoing signaling bits are set to 1111.

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## Channel Associated Signaling (CAS)

Channel Associated Signaling (CAS), also known as Per-Trunk Signaling (PTS), allows CVoIP solutions to interface directly with a wide range of legacy switching systems which use CAS signaling. A large number of Per-Trunk Signaling systems must access the Carrier VoIP network using legacy switching equipment. CAS allows the protocols required to access the Carrier VoIP network to continuously indicate their line state using a limited number

of line state bits (A/B or A/B/C/D bits). These are either carried within the target bearer DS0 using Robbed Bit Signaling (as for DS1s) or are multiplexed together and are carried in the specific signaling channel, timeslot 16 (as for E1s).

MG acts as a relay point for CAS signaling. Incoming CAS signals on the TDM interface are extracted from their CAS variant waveform according to the profile associated with each TDM endpoint and they are signalled to the Media Gateway Controller (MGC) using H.248. In the reverse direction, incoming CAS signals from MGC are applied to the designated TDM endpoints following the description indicated in the associated profile. The MGC controls a call upon receiving CAS signals and according to its switching capabilities as usual.

CAS signaling involves two components, a MGC which is used to set up and tear down calls, and the MG15000 trunk gateway. The interface between both components is the H.248 signaling protocol. Signaling data and bearer data follow different paths.

MG 15000 performs the following functions:

- terminates the physical layer of signaling link on the TDM endpoints
- maintains the H.248 interface to MGC
- TDM input line signaling detection. TDM input register signaling activities: Tone and dial pulse detection.
- TDM output line signaling generation. TDM output register signaling activities: tone and dial pulse generation.
- maintains the journaling activities for carrier grade

VSP3-o and 2pVSP4e supports CAS.

Generic ITU R2 support

- compelled overlap register signaling (icasco package)
- compelled en-bloc register signaling (MFC tonesets: R2F, R2B)
- Support for icas and icasco packages

### **CAS variants**

Any CAS protocol may be hosted on CVoIP through provision of CAS-specific software in the MGC and, CAS-specific datafill or profile on the MG.

### **Supported trunks**

Supported trunks are:

- ATC

- IT
- OP
- ES
- SC
- CELL
- EANT
- ONANT
- DAL
- IBNT1
- IBNT2
- IBNT0
- PX

### Supported profiles

Table [Profile filenames](#) lists the supported profiles. For MG and MGC to function correctly the provisioning of trunk type on the MGC must match the profile provisioned on the MG.

#### Profile filenames

Profile name	Mode header	Inpulse type (s)	Outpulse type (s)	Ringback type	Physical Signaling	Trunk type (provided for information)
ds1SigDtmf	DTMF	DTMF & DP	DTMF & DP	Not Supported	DS1 (or R1)	SC, CELL, DAL, PX, IBNT1, IBNT2 and IBNT0 only
ds1SigMfr1	MF	MF, DTMF & DP (DTMF only via the dd/edd package)	MF & DP only	Expanded In-band	DS1 (or R1)	ATC, IT, OP, ES, SC, CELL, EANT, ONAT, DAL, IBNT1, IBNT2, IBNT0, PX
ds1SigMwMfr1	MF	MF, DTMF & DP (DTMF only via the dd/edd package)	MF & DP only	Multi Wink	DS1 (or R1)	ATC, IT, OP, ES, SC, CELL, EANT, ONAT, DAL, IBNT1, IBNT2, IBNT0, PX

**Profile filenames**

Profile name	Mode header	Impulse type (s)	Outpulse type (s)	Ringback type	Physical Signaling	Trunk type (provided for information)
fxsLsDpdt	DTMF or DP	DTMF or DP	DTMF or DP	Not Supported	FXS Loop Start	DAL & PX only
fxsGsDpdt	DTMF or DP	DTMF or DP	DTMF or DP	Not Supported	FXS Ground Start	DAL & PX only
nullE1	None	None	None	None	E1 CAS multiframed	N/A
nullDs1	None	None	None	None		Not intended for CAS trunks (the sole purpose of this profile is to solve a particular customer non-CAS issue)
BrazilR2	MFC	MFR2	MFR2	Not required	E1 (R2)	
MexicoR2	MFC	MFR2	MFR2	Not Required	E1 (R2)	
KoreaR2	MFC	MFR2	MFR2	Not Required	E1 (R2)	

**Channel Associated Signaling (CAS) profile**

A profile defines the behavior of all DS0s within a primary rate group (DS1). Up to 25 different profiles may be simultaneously supported per VSP. Multiple primary rate groups may use the same profile. The profiles are created by Nortel. Each profile is defined through the optional component CasDefn/n.

CAS profiles are stored on the CP disk (/sfs/software/mg/obj/). The load contains all the profiles that have been defined (maximum profile size is 20k). When a CasDefn component is provisioned, the CAS profile identified by the *fileName* attribute gets downloaded from the CP to the SSM device on the VSP.

**CAS call flow**

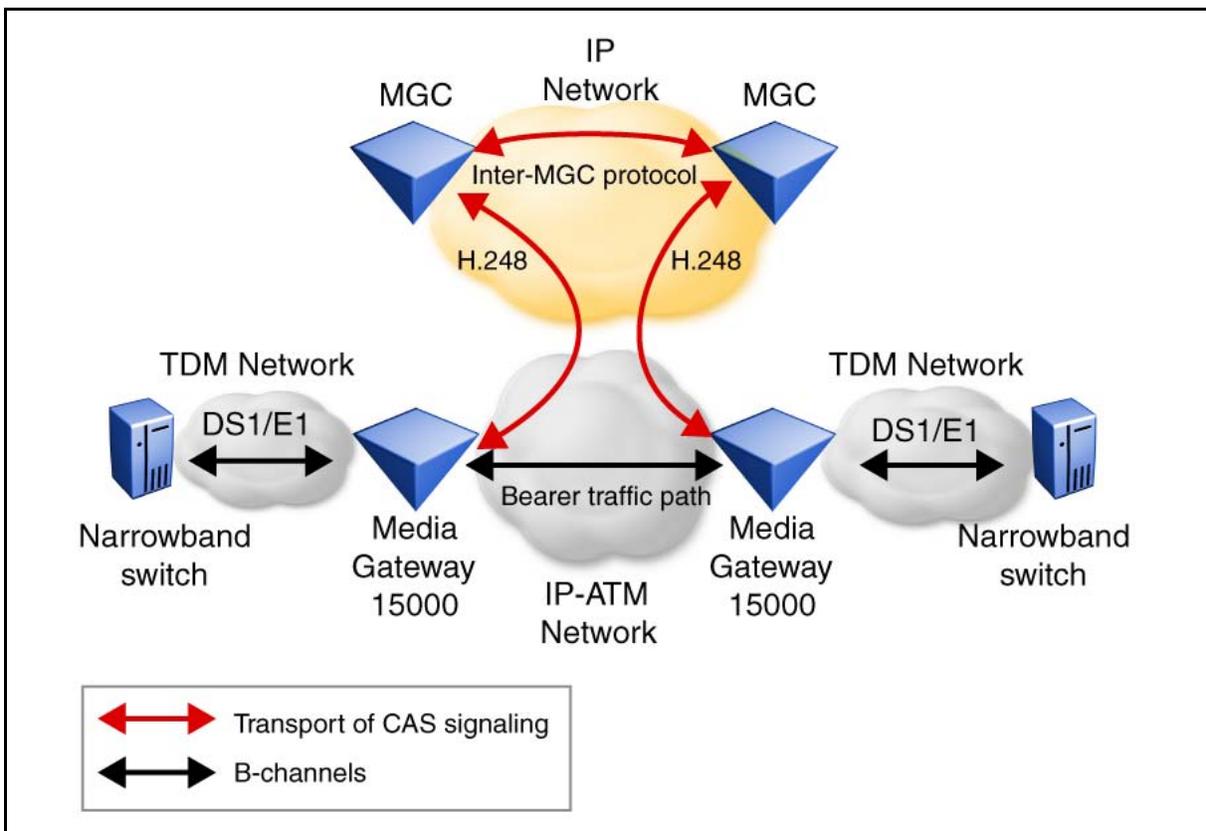
This section provides an example of a call that uses CAS signaling for control setup. Figure [CAS end-to-end call flow](#) shows the end-to-end view. CAS signaling is transported transparently between TDM networks across the

signaling paths between MG and MGC at both sides. Signaling data and bearer data follow different paths. In the example, ATM access to MG is assumed.

The example assumes MG is the gateway at both ends and that MGs are in steady state, provisioned and a valid profile has been downloaded and is operational.

The example flow corresponds to a scenario with non-compelled register signaling and no automatic response to SZG. The call flow does not show the CAS transport of source number identification, calling party category, country code, language, discriminating digit information for international calls nor other controlling information in the narrowband switches.

### CAS end-to-end call flow



### CAS call control

The following are the CAS-related packages supported by MG over H.248:

- •bcas - Basic CAS line-signals/events
- bcasaddr - Basic CAS register-signals/events (extends bcas)
- casblk - CAS blocking line-signal/event

- rbs - Robbed Bit Signaling signals/events
- oses - Operator Services and Emergency Services signals/events
- icas - Additional international CAS line-signals/events (extends bcas)
- icasc - En-bloc compelled register-signals/events
- icasco - Overlap compelled register-signals/events (extends icasc)

## Switching TDM traffic in a LAPS configuration



### CAUTION

#### Risk of service interruption for a LAPS configuration

Other than up to 50 ms of lost traffic due to a switchover in a line automatic protection switching (LAPS) dual-FP configuration, a service outage is possible if the command *switch laps* is not used to switch activity while the spare card is locked. For example, you might enter the command *lock* on a port on the active card while the spare card or port is locked. A service outage occurs because both the active and spare ports are locked. The command *switch laps* checks whether the spare is in-service and available before attempting the switchover. When the port or card is not available, this command prevents the switchover.

When a 4-port OC-3/STM-1 Ch TDM/CES FP (with PEC NTHW70 and card type 4pOC3ChSmIr), or any other optical FP, is set up in a dual-FP LAPS configuration, use the command *switch laps* to switch over traffic from the active card or port to a spare card or port on a Media Gateway shelf. When the spare TDM card is locked, the command *switch laps* responds with a message that the spare card or port is unavailable and the command is aborted. The aborted command results in traffic remaining on the active port. The full description of the command *switch laps* is in *Nortel Multiservice Switch 7400/15000/20000 Commands Reference* (NN10600-050).

## MG carrier grade

MG has robustness functionality in support of carrier grade standards of reliability on Nortel Multiservice Switch 15000 nodes. The following carrier grade features are supported by MG on Multiservice Switch 15000 nodes:

- [Hitless equipment protection \(HEP\) \(page 101\)](#)
- [Hitless Software migration \(HSM\) \(page 103\)](#)

MG support of the carrier grade features HEP and HSM only apply to the following types of FPs on a MG:

- 4-port OC-3/STM-1Ch TDM FP
- VSP2/VSP3/2pVSFP (except gigabit Ethernet features of the VSP3 FP which are not supported)
- VSP3-o FP
- 2pVSP4e FP
- ATM FP
- 4-port gigabit Ethernet FP card as described in [4pGe FP card support of carrier grade \(page 54\)](#)

Other considerations for support of HEP and HSM are as follows:

- supported for switched MG using either ATM or IP
- supported for the H.248 version 1 protocol for connection control between the MG and the MGC
- supports VrAp <--> SpvcAp data network access re-provisioning without VSP-type card reset
- cannot provision border gateway protocol (BGP) when 4-port gigabit Ethernet FP card is on the MG shelf (a warning is generated when BGP is provisioned as part of another VR on the MG shelf and a 4-port gigabit Ethernet FP card is on the MG shelf)
- integrates support of multiple virtual routers (MVR) on 4-port gigabit Ethernet FP card
- supports hot control processor switchover (CPSO) for switched MG using ATM or IP with virtual router (VR) interworking by provisioning component *VirtualRouterAccessPoint (VrAp)* (see [Hot CPSO \(page 101\)](#))

HEP or HSM switchovers on MG have the following impacts:

- packet data loss of voice and VBD is limited to 100 ms (except for virtual router (VR) interworking by provisioning component *VirtualRouterAccessPoint (VrAp)* that is limited to one second)
- period of degraded performance for quality of voice is normally limited to 400 ms (except for virtual router (VR) interworking by provisioning component *VirtualRouterAccessPoint (VrAp)* that is limited to one second)
- narrowband call setup outage (setup, modify, delete) has a maximum value of 15 s (the typical value is less than 10 s)
- SPVC connections are maintained across HEP or HSM
- SVC connections both endpoint provisioned or dynamic are maintained across HEP or HSM

- PVC connections are not maintained across HEP or HSM
- there is a small chance that clear channel data (CCD), fax, and modem calls might not survive HEP or HSM switchovers with VrAp (there is small packet loss under one second for these types of calls)

### Hot CPSO

Hot control processor switchover (CPSO) allows FPs with services running to continue operating without interruption during a CP switchover of node control from the active CP to the standby CP. For additional information on CPSO, see 241-5701-600 *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550). MG support of hot CPSO has the following impacts:

- hot CPSO is supported for static IP routes and dynamic open shortest path first (OSPF) routes enabled on the VR
- MG recovery is limited to 50 ms
- hot CPSO is supported in a configuration of switched MG using IP (VoIP) with Ethernet transport and VR; see [4pGe FP card support of carrier grade \(page 54\)](#)

### Hitless equipment protection (HEP)

MG supports HEP to preserve service on supported FP cards in a 1 + 1 or 1:1 processor sparing configuration. A configuration of 1 + 1 sparing has two active FP cards but only one of the cards has active service and the other card is in a standby state prepared to change to the active service. A configuration of 1:1 sparing has two FP cards with one card in active service and the other card not active but can be brought into active service as a replacement for the first card. Media Gateway support of HEP requires a standby configuration of each of the FP cards in a MG. HEP supports the following:

- supports hitless protection on 1:1 sparing configuration of VSP2/VSP3 FPs (one card is active and other card is standby)
- supports hitless protection on 1 + 1 sparing configurations of VSP3-o/2pVSP4e FPs (both cards are active but one card has the active service and the other card has the standby service)
- supports hitless protection on 1 + 1 sparing configurations of 4-port OC-3/STM-1Ch TDM FPs (both cards are active but one card has the active service and the other card has the standby service)
- supports the addition of a hot-standby 1:1 sparing pair of VSP2/VSP3 FPs on the Nortel Multiservice Switch 15000 shelf
- supports the addition of a hot-standby 1 + 1 sparing pair of VSP3-o/2pVSP4e FPs on the Nortel Multiservice Switch 15000 shelf
- supports the provision of an unprotected active VSP2/VSP3 FP with hot-standby 1:1 sparing configuration of VSP2/VSP3 FPs

- supports the provision of an unprotected active VSP3-o/2pVSP4e FP with hot-standby 1 + 1 sparing configuration of VSP3-o/2pVSP4e FPs
- supports all the MG services that are supported by HSM
- VSP HEP is supported by virtual router (VR) interworking by provisioning component *VirtualRouterAccessPoint (VrAp)* for switched MG (VoATM and VoIP) - see [VSP HEP for switched MG with VR interworking \(page 102\)](#)

### **VSP HEP for switched MG with VR interworking**

VSP HEP is supported for switched MG using IP or ATM functionality when using VR interworking (by provisioning component *VrAp*), and a 4-port gigabit Ethernet FP card or an ATM IP FP card that is carrier grade compliant. VR interworking with the VSP2, VSP3, VSP3-o, and 2pVSP4e FP cards, provides IP routing on the MG without the need for an external router (an external router is not required for traffic forwarding between VSP2/VSP3/VSP3-o/2pVSP4e FP cards connected to the same VR).

Considerations for support of VSP2 and VSP3 HEP for switched Media Gateway using VR interworking, are as follows:

- supports VSP2 and VSP3 in 1:1 spared configuration (does not support 1:N spared configuration of VSP2 and VSP3)
- supports static routing and dynamic routing through open shortest path first (OSPF) routes
- supports a maximum outage time of one second for VSP2 and VSP3 HEP

VSP2 and VSP3 HEP is supported for the following cards in a MG shelf configuration:

- 4-port OC-3/STM-1Ch TDM FP
- control processor 3 (CP3) that support building integrated timing supply (BITS) as follows:
  - DS1 BITS CP (NTHW06)
  - E1 BITS CP (NTHW08)
- 4-port OC-3/STM-1 ATM FP (PQC12-based NTHW05)
- 4-port OC-12/STM-4 ATM FP (PQC12-based NTHW86)
- 4-port gigabit Ethernet FP (NTHW49)

Considerations for support of VSP3-o/2pVSP4e HEP for switched MG using VR interworking, are as follows:

- supports VSP3-o/2pVSP4e in 1 + 1 spared configuration (does not support 1:N spared configuration of VSP3-o) for the TDM ports and using

dual LP equipment protection (DLEP) sparing through the *Vsp* subcomponent of component *DualLpEquipmentProtection (Dlep)*

- supports static routing and dynamic routing through open shortest path first (OSPF) routes
- supports a maximum outage time of one second for VSP3-o HEP

VSP3-o HEP is supported for the following cards in a MG shelf:

- control processor 3 (CP3) that support building integrated timing supply (BITS) as follows:
  - DS1 BITS CP (NTHW06)
  - E1 BITS CP (NTHW08)
- 4-port OC-3/STM-1 ATM FP (PQC12-based NTHW05)
- 4-port OC-12/STM-4 ATM FP (PQC12-based NTHW86)
- 4-port gigabit Ethernet FP (NTHW49)

2pVSP4e HEP is supported for the following cards in a MG shelf:

- control processor 3 (CP3) that support building integrated timing supply (BITS) as follows:
  - DS1 BITS CP (NTHW06)
  - E1 BITS CP (NTHW08)
- 4-port gigabit Ethernet FP (NTHW49)

### **Hitless Software migration (HSM)**

MG supports HSM to allow for changes to the MG software load without service interruption. MG support of HSM requires all the CP and FP cards involved in a MG call to have HSM functionality. This HSM functionality includes the synchronization of call states across the fabric interface. HSM supports the following:

- supported on MG configurations of 1:1 sparing for VSP2/VSP3 FPs and 1 + 1 sparing for 4-port OC-3/STM-1Ch TDM FPs
- supports hitless recovery sequence and operator control
- supports echo cancellation, silence suppression, and comfort noise
- supports VBD, CCD, and upspeed to G.711 call compression (CCD calls are not supported for configurations using VrAp functionality)
- supports DTMF relay and fax relay (no support for T.38 fax relay in progress; fax calls are not supported for configurations using VrAp functionality)
- supports hard-coded tones and continuity test (COT) to the public switched telephone network (PSTN)

- supports PRI backhaul (no support of V5.2 backhaul)
- supports SS7 backhaul
- supports mid-call digit collection (except for mid-call, HSM has no support for digit collection in progress using digit maps and individual digit collections)
- management connectivity is not maintained in full during HSM
- hitless software downgrade to a previous version is not supported
- HSM progress indication is not supported
- virtual router (VR) interworking by provisioning component *VirtualRouterAccessPoint (VrAp)* is supported for VSP HSM (using VSP2, VSP3, and VSP3-o) in the configuration of switched MG with VR interworking - see [VSP HSM for switched MG with VR interworking \(page 104\)](#)
- HSM is supported in a configuration of switched MG using IP (VoIP) with Ethernet transport and VR; see [4pGe FP card support of carrier grade \(page 54\)](#)

A description of HSM for Multiservice Switch 15000 nodes is found in *Nortel Multiservice Switch 7400/15000/20000 Installation – Software* (NN10600-270).

### **VSP HSM for switched MG with VR interworking**

VSP HSM is supported for switched MG using IP or ATM functionality in a configuration using VR interworking (by provisioning component *VrAp*) and PQC12-based ATM IP FP cards (4-port OC-3/STM-1 ATM FP or 4-port OC-12/STM-4 ATM FP). The ATM IP FP cards must be spared with line automatic protection switching (LAPS).

Considerations for support of VSP HSM for switched MG using VR interworking, are as follows:

- supports VSP2, VSP3, VSP3-o, and 2pVSP4e in 1:1 spared configuration (does not support 1:N spared configuration of VSP2, VSP3, VSP3-o, and 2pVSP4e)
- supports static routing (does not support dynamic routing through OSPF routes)
- supports a maximum outage time of one second for VSP HSM
- no support when the 4-port gigabit Ethernet FP is part of the MG shelf
- Laps mode can be configured as unidirectional or bidirectional with reversible or non-reversible behavior as required. Both ends of the LAPS pair must be provisioned with the same mode and the same reversible behavior.

VSP HSM is supported for the following types of cards in a MG shelf configuration:

- VSP-type cards as follows:
  - VSP2 FP (NT0482 on Multiservice Switch 7400, NTHW87 on Multiservice Switch 15000)
  - VSP3 FP (NTHW84)
  - VSP3-o FP (NTHW77)
  - 2pVSP4e FP (NTHW26)
- 4-port OC-3/STM-1Ch TDM FP
- control processor 3 (CP3) that support building integrated timing supply (BITS) as follows:
  - DS1 BITS CP (NTHW06)
  - E1 BITS CP (NTHW08)
- 4-port OC-3/STM-1 ATM FP (PQC12-based NTHW05)
- 4-port OC-12/STM-4 ATM FP (PQC12-based NTHW86)

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# Media Gateway as a Host

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The Media Gateway (MG) 15000 as host feature offers optional configurations that enable you to simplify your network configurations for MG15000 and associated NextHop Routers (NHRs). The MG15000 with GigE interface cards are setup with VSP host Devices configured to appear as host interfaces to adjacent NHRs.

The configurations use a Dual-homed dual router deployment topology that puts the MG 15000 and NHRs on the same subnet from the NHR's perspective. The Dual-homed dual router deployment makes use of VRAP local subnets to allow L2 bridging and L3 routing. Network configuration is simplified when the MG15000 is configured as a host because there is no need to provision routing protocols on the MG15000.

The MG15000 as host makes the following changes on the node:

- changes the existing IP Network Addressing scheme
- adds support for Gratuitous ARP and restricted Proxy ARP functionality on the 4pGE interfaces
- adds Protected IP NextHop Route metric support

## MG host configurations

There are supported topologies - Topologies 1, 2, and 3. Topology 1 is a Remote subnet configuration used in past releases where the MG's VSP cards' subnets are remote to the next hop router (NHR). Topology 2 is the Local host configuration which is supported as a Bridged Local Host configuration that can be configured in a Dual-Homed dual router deployment as one of two sub-topologies (Topology 2a or Topology 2b).

From the perspective of the MG15000, there is no difference between Topology 2a and Topology 2b, however, from a network configuration perspective (specifically on the NHRs), the appropriate configuration of the L2 device bridging capabilities between NHRs differentiates the topologies.

When MG15000 is configured as a host in either the Topology 2a or Topology 2b configurations, a Next Hop Router (NHR) sees the MG15000 as a Local Host Device with L2 Bridging between the GigE links (VRAP local subnet). With this topology the NHR can forward IP packets to the MG15000 using Layer 2 switching facilities which key on the MAC address of the 4pGE card in the MG15000. The following topologies are supported:

- Topology 1 (Remote subnet configuration), MG15000 appears as an L3 router to the NHRs where the NHRs can use L2 bridging or L3 routing between themselves. The VSP cards' subnets are remote to the NHR, such that the NHR requires static routes or OSPF to forward IP packets to the VSP cards.
- Topology 2 (Bridged local host configuration), the VSP cards' subnets appear to be local to the NHR for IP, therefore, IP routing is not required. The NHR uses ARP to resolve the L2 addresses required to forward the IP packets to the VSP cards.
  - Topology 2a (Hybrid-Bridged Local Host), the L2 device and NHR are combined as one box. The adjacent L2 switches are actually hybrid L2/L3 devices that are also the NHRs themselves, see the figure [Topology 2a: Hybrid-bridged local host \(page 109\)](#).
  - Topology 2b (Pure-Bridged Local Host), the L2 device and NHR are individual boxes. The NHRs are separate network elements from the L2 switches which sit between the NHR and the MG15000, see the figure [Topology 2b: Bridged local host \(page 109\)](#).

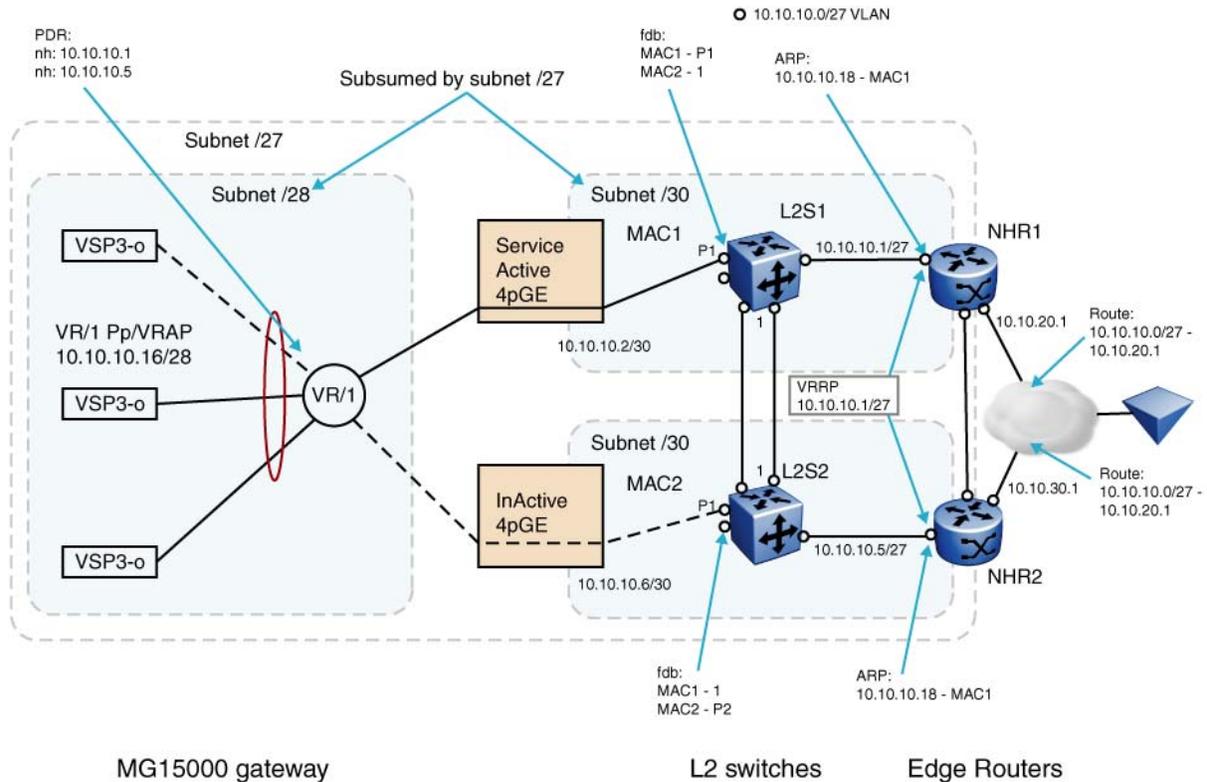
### Subnet configuration

The figure [Subnetting role in the local host device topologies \(page 108\)](#) is an illustrated example of how the MG and NHRs are configured in the same subnet using a single VR model. This illustration is for reference purposes, however, the configuration is supported. From a MG15000 perspective, the VRs have three protocol ports (three subnets) as follows:

- a /28 subnet for VRAP of all the NSTA VGS sub-components
- a /30 subnet for each of the GigE links
- a /27 subnet for the router ports as this will be how the adjacent routers will view the MG15000

For the trunking ports (4pGE ports) to appear as locally attached hosts to the NHRs, the Vr that supports the GigE ports for the local host configuration must have the *localHostDeviceTopology* attribute of the Vr CustSpec component set to *layer2*. This allows the Hosts that are not locally attached to the NHR (in this case the VSP Hosts) to appear as individual ARP entries in the NHR's ARP table. There is an individual VSP IP to MAC mapping in the NHR's ARP table for each VSP Host IP address. IP Packets from the NHRs are forwarded to the GigE port via these ARP table entries.

**Subnetting role in the local host device topologies**



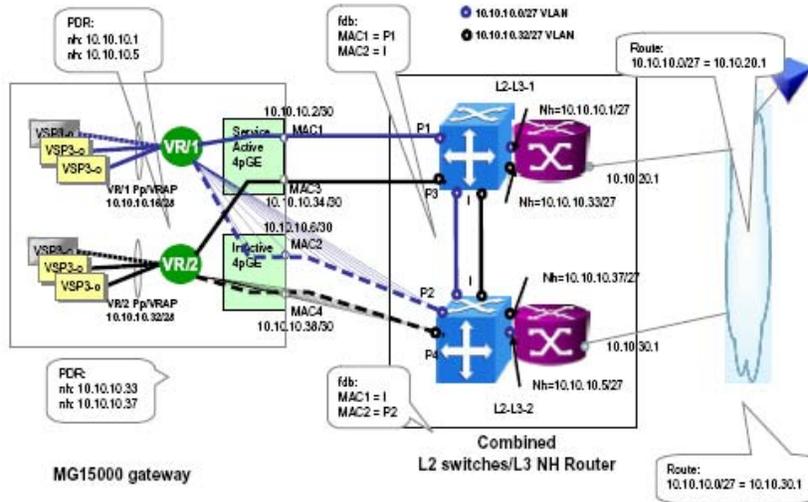
**Dual-Homed dual router deployment**

[Topology 2a: Hybrid-bridged local host](#) and [Topology 2b: Bridged local host](#) and illustrate the Dual-Homed dual router network topologies where the VSP Hosts (VSP IP Addresses) on MG15000 appear as Local Hosts that are reachable directly from the adjacent NextHop Routers via a layer2 bridge. In these configurations the MG15000 continues to route (L3 routing) internally between the VSP Hosts and GigE links, and the VRs are configured, as in the existing Topology 1 solution, with PDR to route all packets out through the working GigE link.

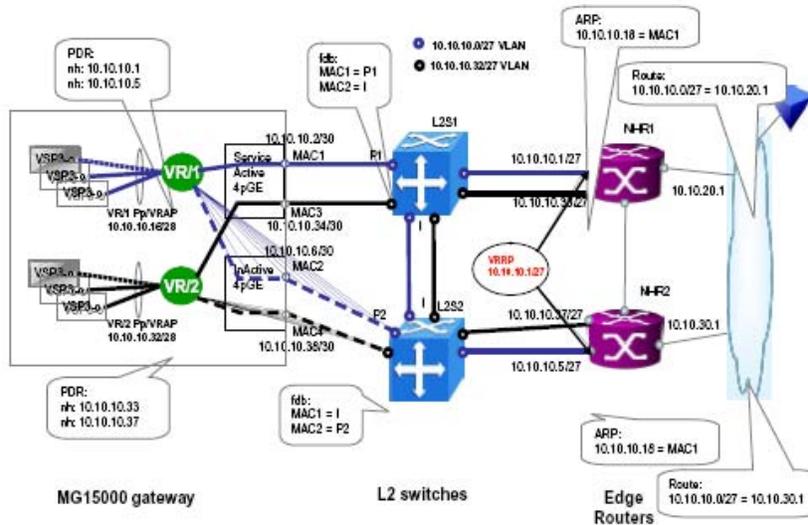
**MG15000 as a Local Host Device with L2 Bridging (Topology 2)**

Both [Topology 2a](#) and [Topology 2b](#) illustrate the configuration of MG15000 as a local host device with L2 bridging, see the figure [Topology 2a: Hybrid-bridged local host](#) and [Topology 2b: Bridged local host \(page 109\)](#). Refer to NN10600-782, MG Switched service configuration management for configuration details.

**Topology 2a: Hybrid-bridged local host**



**Topology 2b: Bridged local host**



Refer to NN10600-782, MG Switched service configuration management for configuration details.

**NHR configuration**

Configuration of the MG15000 as a host requires specific configuration on the adjacent routers to inter-connect with the 4pGE on an MG VR Host Interface as follows:

- Ports must be connected to a L2 Ethernet bridging capable box before connecting to L3 routed ports. ERS8600 can support the functionality of both in one box.

- When using Topology 2b, VRRP must be configured on the two adjacent NHRs in master/slave mode. The VRRP Master IP address is configured to match that of the PDR preferred Next Hop IP address on the NHR.
- When using Topology 3, the NHRs must be configured to switch from LOCAL Subnet to Remote Subnet in less than 1 second.
- Auto-neg enabled
- SX or LX interface support
- Dual-homed GigE to next-hop routers to allow the provisioning of multiple routed ports on the same subnet. The two routers must be interconnected to each other via an L2 Transparent Bridge.
- Policy routing/filtering
- GARP packets processing support

## Carrier grade functionality

Carrier grade functionality, CPSO, HSM, and HEP, are supported for IP on 4pGE cards that use Protected Default Routes (PDR). The Protected Routes capability for VoIP with VR interworking (VrAp) continues to provide 4pGE HEP and HSM support when LAG is deployed, however, additional capabilities simplify the MG15000 4pGE Carrier Grade configuration. The PDR HeartBeat mechanism monitors the health of the GigE links and routing preference is determined from the health of the GigE link at a Layer 3 level.

The MG15000 Host Device supports existing Carrier Grade requirements for the 4pGE card as follows:

- Port / card failure recovery with a 1 second maximum of IP traffic loss from the moment of failure
- Hitless software migration with a 1 second maximum of IP traffic loss from the moment the MG15000 switches between shelf running old software and shelf running new software
- CPSO with a 1 second maximum of IP traffic loss when static routes and OSPF routes are used

## MG15000 as host protection

An MG15000 with GigE configured as a Layer 2/Layer 3 Host Device in a network provides protection capabilities similar to that of Optical ATM FPs. Unlike Optical ATM FPs which use APS to support link / port failure protection and hitless software migration there is no APS (or similar) protocol defined for the GigE standard. However, an MG configured as a Layer 2/3 host introduced into the network provides protection capabilities similar to that of Optical ATM FPs. This protection capability is realized with MG as host because the existing IP Network Addressing scheme changes, the PDR capabilities are leveraged, and restricted Proxy ARP on 4pGigE are added.

## **MG15000 as host OMs (5 and 30 min PMs) Collection**

The local host device configuration changes the steady state and failure mode traffic flows and if you monitor your IP layer OMs, you will see some changes in your OM reports. As with the routed configuration, the PDR sends traffic on one of the two GigE links, only. With the reversible PDR in these configurations, under steady state condition, you will see IP “OUT” counts on Lp/2 ethernet ports, only.

You can expect that no user traffic will be seen on Ip/3’s Ethernet ports, neither “IN” nor “OUT” for L2 local hosts because ARP only operates on the GigE port that has the active PDR nextHop (Lp/2 ethernet ports under steady state).

You can setup threshold-cross alarms on your IP OMs to flag potential network incidents; for example, in the L2 configuration, if any appreciable amount of traffic is seen on the Lp/3 GigE links (for example 1000packets/second), some fault or maintenance action has happened to either Lp2, Lp/2 ethernet link, or the L2 switch adjacent to Lp/2.

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# ATM connections for Media Gateway

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This section describes ATM connections and how the Media Gateway (MG) uses them. For more information, see

- [ATM PVCs \(page 112\)](#)
- [ATM SPVCs \(page 113\)](#)
- [ATM SVCs \(page 117\)](#)
- [ATM PSVCs \(page 119\)](#)
- [ATM network addressing \(page 124\)](#)
- [Monitoring alarm signals and indications \(page 127\)](#)
- [Retry mechanism \(page 128\)](#)
- [Behavior on CP switchover \(page 130\)](#)
- [On-switch PSVC loops \(page 130\)](#)

## ATM PVCs

ATM PVCs are static data paths that run through the ATM network. PVCs use permanent connections that are provisioned at the originating Media Gateway, each ATM node in the ATM network, and the terminating Media Gateway. The user selects the route for an ATM connection and provisions this connection at each hop in the ATM network.

If a network facility fails along the selected route, the ATM connection also fails for the duration of the outage. There is no automatic rerouting possibility. This type of connection failure may require a correction in the configuration of the ATM node that caused the fault. .

All types of MG can use ATM PVCs, including non-switched Media Gateway, and switched MG using ATM.

For details on how MG can use ATM PVCs, see

- [Network scenarios for using MG and ATM PVCs \(page 113\)](#)
- [Application access points \(page 113\)](#)

Additional details about ATM PVCs can be found in *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702).

### Network scenarios for using MG and ATM PVCs

For non-switched MG, PVCs can be used for both the AAL2 VCCs that carry voice traffic and in-band signaling information and the AAL5 VCCs that carry out-of-band signaling information. This network scenario is shown in [Non-switched Media Gateway application \(page 30\)](#).

For switched MG using ATM, PVCs can be used for AAL2 VCCs that carry bearer traffic, AAL5 VCCs that carry control information, and AAL1 VCCs that carry signaling from the 4-port OC-3/STM-1Ch TDM/CES FP. This network scenario is shown in [Switched MG using ATM \(page 42\)](#).

Also, the router that directs traffic from the ATM network to the IP network must support ATM PVCs. This network scenario is shown in [VoIP using ATM transport and external routing \(page 52\)](#).

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**Attention:** The 4-port OC-3/STM-1 Ch TDM/CES FP does not support PVCs for the TDM FP connection to the VSP2, or VSP3 FPs.

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**Attention:** The VSP3-o FP card does not support PVC connections.

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### Application access points

An access point is used by an application to define the ATM network access. It is linked to the connected endpoint of an ATM network. For MG, the *Nsta Vgs AtmTConn* component, the *Nsta Vgs Ctrl* component, and the *Nsta Conn* component, are examples of applications that use access points.

To use PVCs, MG applications have a *Nailed-up AccessPoint* (NAP) subcomponent. The NAP is manually linked to a *Nailed-up EndPoint* (NEP) subcomponent of a provisioned ATM VCC.

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**Attention:** The 4-port OC-3/STM-1 Ch TDM/CES FP does not support PVCs for the TDM FP connection to the VSP, VSP2, or VSP3 FP.

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**Attention:** The VSP3-o FP card does not support PVC connections.

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## ATM SPVCs

ATM SPVCs are permanent connections established automatically through an ATM network. SPVCs allow ATM connections to be made between one end that supports SVCs and another end that supports only PVCs.

When SPVCs are used, the source application originates an ATM call to a destination ATM interface. The ATM networking system terminates the ATM call at the destination ATM interface. The ATM networking system selects an optimal route and establishes the connection using signaling procedures. Once the connection is established, the source endpoint of the ATM connection is linked to the source application.

All types of MG can use a type of ATM SPVC called an ATM provisioned SPVC.

For details on how MG uses ATM PSVCs, see

- [Network scenarios for using MG and ATM provisioned SPVCs \(page 114\)](#)
- [Application access points \(page 120\)](#)
- [ATM signaling \(page 121\)](#)
- [ATM call processing \(page 116\)](#)

Additional details about ATM SPVCs can be found in *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702).

### **Network scenarios for using MG and ATM provisioned SPVCs**

For non-switched MG using ATM, provisioned SPVCs can be used for the AAL2 VCCs. The AAL2 VCCs carry bearer traffic. CCS is transported as CCD by provisioning timeslot 24 for DS1 and timeslot 16 for E1. CAS is not supported for provisioned SPVCs in non-switched MG. This network scenario is shown in [Non-switched Media Gateway application \(page 30\)](#).

For switched MG using ATM, ATM SPVCs can be used if the router that directs control information from the ATM network to the IP network and to the MGC supports only ATM PVCs. In this case, the ATM VCCs from the source application are terminated on the node at the edge of the ATM network. The router is then linked to the ATM edge node using PVCs. This network scenario is shown in [Switched MG using ATM \(page 42\)](#).

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**Attention:** The VSP3-o FP card does not support PVC connections.

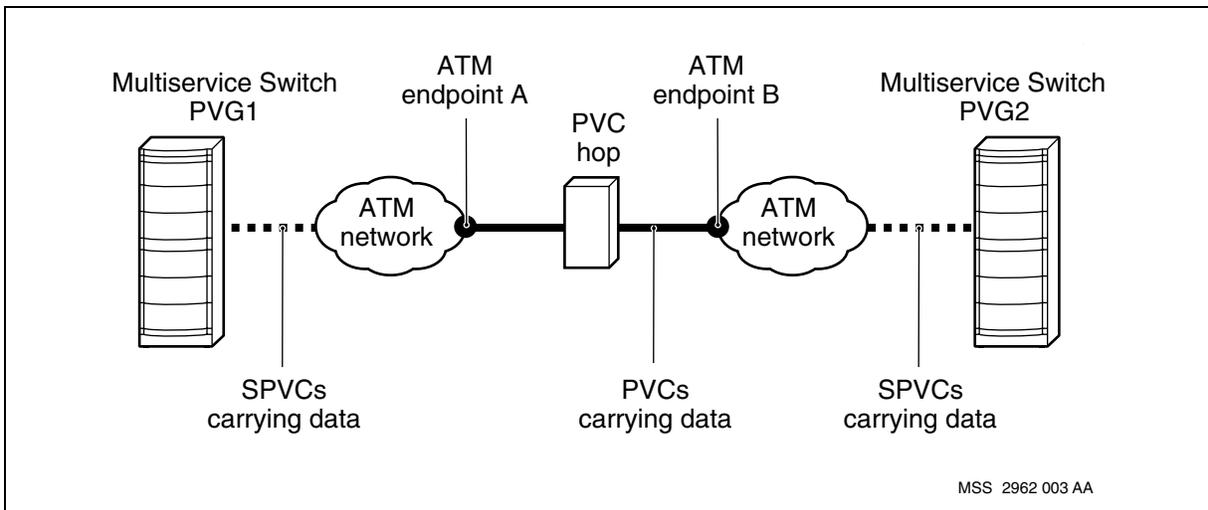
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Similarly, ATM SPVCs can be used if the router that directs traffic from the ATM network to the IP network supports only ATM PVCs. This network scenario is shown in [VoIP using ATM transport and external routing \(page 52\)](#).

As well, ATM SPVCs can be used where two ATM networks are between two MGs and the two ATM networks are connected together by a hop that supports only ATM PVCs. See [ATM SPVCs for trunks between two Media Gateways \(page 115\)](#).

In this case, SPVCs are used to create dynamic trunks. The ATM trunk between MG1 and MG2 consists of two SPVCs and one PVC that connects the SPVCs together. One SPVC runs from MG1 and terminates at ATM endpoint A. The other SPVC runs from MG2 and terminates at ATM endpoint B. The PVC connects points A and B. Both MGs establish SPVCs with the same remote VPI/VCI combination that is used by the PVC.

### ATM SPVCs for trunks between two Media Gateways



### Application access points

An access point is used by an application to define the ATM network access. It is linked to the connected endpoint of an ATM network. For MG, the *Nsta Vgs AtmTConn* component, the *Nsta Vgs Ctrl* component, and the *Nsta Conn* component, are examples of applications that use access points.

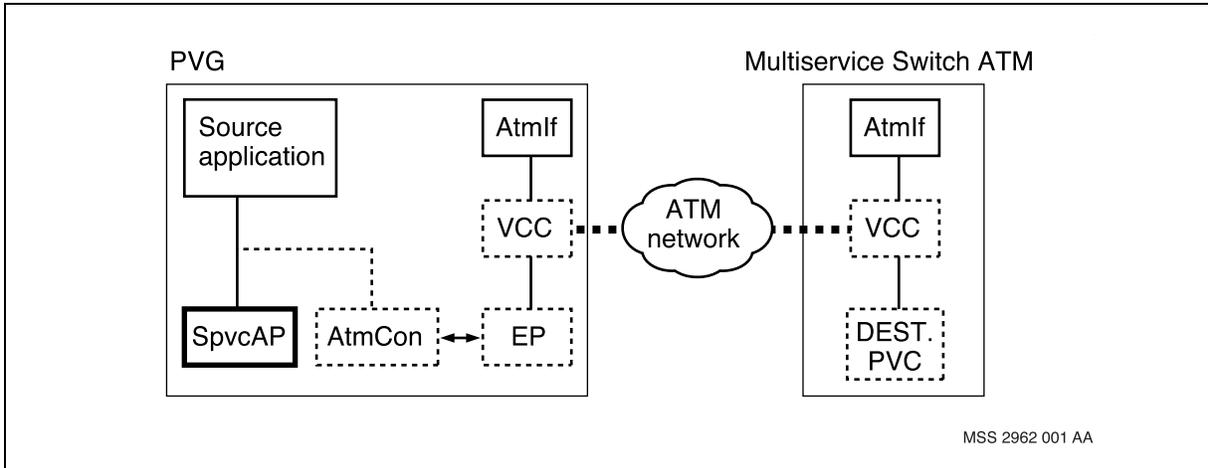
For provisioned SPVCs, applications use an *SpvcAccessPoint (SpvcAp)* component as the access point.

**Attention:** The *Nsta Vgs AtmTConn SpvcAp* component is not identical to the *Nsta Vgs Ctrl SpvcAp* component. For example, you can set three addresses in a list for the *addressToCall* attribute of the *Nsta Vgs Ctrl SpvcAp* component while you can only set one address for the equivalent attribute of the *Nsta Vgs AtmTConn SpvcAp* component.

The *SpvcAp* subcomponent of an application defines SPVC connectivity information and generates SPVC calls to the ATM network. The ATM network terminates the SPVC call on a provisioned ATM VCC. If the destination ATM interface is on a Nortel Multiservice Switch node, a dynamic VCC with a *DestinationPVC (DST)* subcomponent is the end point of the SPVC. The figure [SPVC access point and destination PVC for ATM SPVCs \(page 116\)](#) shows this relationship.

Once the ATM connection is established, the application on the calling end is linked through an *atmConnection (atmCon)* component and an *EndPoint (EP)* component. The *EP* component is a subcomponent of a dynamic VCC under the ATM interface at the calling end of the connection. The *atmCon* component is a dynamic operational component and is linked to the *EP* component. The *atmCon* component acts as a dynamic bridge for the application.

### SPVC access point and destination PVC for ATM SPVCs



### ATM signaling

MG establishes, maintains and clears ATM SPVCs by using three types of ATM signaling messages:

- SETUP, to request the establishment of a connection
- CONNECT, to show that a connection has been established
- RELEASE, to clear a connection

For additional information on ATM signaling, see *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702).

### ATM call processing

MG applications can originate SPVC calls, but cannot terminate them.

For non-switched MG using ATM, the MG application is

- the *Nsta Connection (Conn)* component, for the AAL2 VCCs carrying bearer traffic and in-band signaling with control information

For switched MG using ATM, the MG applications are

- the *Nsta Vgs ControlConnection (Ctrl)* component, for the AAL5 VCC carrying control information

- the *Nsta Vgs AtmTrunkConnection (AtmTConn)* component, for the AAL2 VCCs carrying bearer traffic

For switched MG using IP, the MG applications are

- the *Nsta Vgs ControlConnection (Ctrl)* component, for the AAL5 VCC carrying control information
- the *Nsta Vgs IpMediaStreamConnection (IpMConn)* component, for the AAL5 VCCs carrying bearer traffic

The *SpvcAp* subcomponent of the *Ctrl* component has three provisioned attributes related to call processing: *localAddress*, *addressToCall* and *remoteVpiVci*. The *localAddress* attribute specifies the Media Gateway application's unique ATM address. As with the PSVC active access point, the *addressToCall* attribute can contain up to three remote ATM addresses. The *remoteVpiVci* attribute specifies the virtual path identifier/virtual channel identifier (VPI/VCI) combination for the remote VCC. The VPI/VCI combination is independent of the remote end's ATM address. The VPI/VCI combination is the same regardless of which address is used from the *addressToCall* list.

The *SpvcAp* subcomponent of the *AtmTConn* component has only two provisioned attributes related to call processing: *addressToCall* and *remoteVpiVci*. The local ATM address is derived from the *gatewayAtmAddress* attribute of the parent *Vgs* component. The *addressToCall* and *remoteVpiVci* attributes are similar to those for *SpvcAp* subcomponent of the *Ctrl* component described previously.

The *SpvcAp* subcomponent of the *IpMConn* component is similar to the *SpvcAp* subcomponent of the *Ctrl* component described previously.

When the called end receives an SPVC call, it is terminated on the local application with a *localAddress* that matches the called address in the received SETUP message.

## ATM SVCs

ATM SVCs are dynamic virtual circuit datapaths that run through the ATM network. They are dynamically set up and torn down as required by end-user applications.

When SVCs are used, the source application originates an ATM call to a destination application. The destination application terminates the ATM call. The ATM networking system selects an optimal route and establishes the connection using signaling procedures. Once the connection is established, the endpoints of the ATM connection are linked to the applications.

Switched MG using ATM can use SVCs.

**Attention:** Nortel Networks Communication Server 2000 (CS2000) with H.248 protocol is supported.

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See *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702) for a more complete description of ATM SVCs.

### **Network scenarios for using MG and ATM SVCs**

For switched Media Gateway using ATM, SVCs can be used for the AAL2 VCCs that carry bearer traffic.

The VSP2/VSP3/VSP3-o FP from one MG can automatically create an AAL2 VCC using SVC signaling over the ATM network to a remote MG when extra bandwidth is required between the two MGs. When the bandwidth is no longer required, the MG which originated the SVC deletes it.

SVC creation is triggered by connection requests received from the media gateway controller which requires more bandwidth than is available in current SVCs. SVC deletion decisions are triggered by timeout expiry on empty SVCs.

Once SVC creation has been triggered, the SVC lifecycle is independent of the call that triggered its creation. In this way, SVCs can be used for single calls or multiple calls.

MG can also be provisioned to pre-create SVCs. This means that an SVC set up is initiated when the bandwidth available in existing VCCs between two MGs is reduced to a level that would require a new SVC for the next call.

All SVCs automatically created by a VSP2/VSP3/VSP3-o FP are of the same type, size, and characteristics. The parameters used for the creation of automatic SVCs are defined in the *Profile* component. One *Profile* component is supported per VSP2/VSP3/VSP3-o FP. Profile changes while MG is in service are supported; the changes will only affect SVCs created after the profile changes.

SVCs can co-exist with PSVCs, SPVCs, and PVCs on the same VSP2/VSP3/VSP3-o FP.

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**Attention:** There is a limit of 500 inbound SVCs and 500 outbound SVCs. There is also a limit of a total of 1500 VCCs which can consist of 1000 SVCs along with 500 VCCs consisting of any combination of PSVCs, SPVCs, and PVCs.

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**Attention:** SVCs are supported on Nortel Multiservice Switch 15000 VSP2/ VSP3/VSP3-o FP cards and Multiservice Switch 7400 VSP2 FP cards. All Multiservice Switch 7400 CQC-based ATM FPs are supported but not recommended. For further information, contact Nortel support.

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## ATM PSVCs

ATM SVCs are dynamic virtual circuit datapaths that run through the ATM network. They are dynamically set up and torn down as required by end-user applications.

When SVCs are used, the source application originates an ATM call to a destination application. The destination application terminates the ATM call. The ATM networking system selects an optimal route and establishes the connection using signaling procedures. Once the connection is established, the endpoints of the ATM connection are linked to the applications.

MG uses a type of SVC called PSVC where the user must provision the application to use SVCs instead of PVCs or SPVCs. However, once the initial provisioning is done, SVC generation is automatic.

All MG applications can use PSVCs.

For details on how MG uses ATM PSVCs, see

- [Network scenarios for using MG and ATM PSVCs \(page 119\)](#)
- [Application access points \(page 120\)](#)
- [ATM signaling \(page 121\)](#)
- [ATM call processing for non-switched and switched MG using ATM \(page 121\)](#)
- [ATM call processing for switched MG using IP \(page 123\)](#)
- [Additional call processing details \(page 124\)](#)
- [Additional call processing details for AAL5 VCCs \(page 124\)](#)

See *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702) for a more complete description of ATM SVCs.

### Network scenarios for using MG and ATM PSVCs

For non-switched MG using ATM, PSVCs can be used for the AAL2 VCCs. The AAL2 VCCs carry bearer traffic. CCS is transported as CCD by provisioning timeslot 24 for DS1 and timeslot 16 for E1. CAS is not supported for provisioned SPVCs in non-switched MG. This network scenario is shown in [Non-switched Media Gateway application \(page 30\)](#).

For the 4-port OC-3/STM-1 Ch TDM FP PSVCs can also be used for AAL1 VCC's carrying signaling information.

For switched MG using ATM, PSVCs can be used for the AAL2 VCCs that carry bearer traffic. Also, the router that directs control information from the ATM network to the IP network and to the media gateway controller must support ATM SVCs. This network scenario is shown in [Switched MG using ATM \(page 42\)](#).

For switched MG using IP, PSVCs can be used for the AAL5 VCCs that carry bearer traffic. The PSVCs are IP encapsulated VCCs using the protocol specified in RFC 1483. Also, the router that directs traffic from the ATM network to the IP network must support ATM SVCs and the Interim Link Management Interface (ILMI). This network scenario is shown in [VoIP using ATM transport and external routing \(page 52\)](#).

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**Attention:** Depending on the level of ILMI that the router supports, additional restrictions may apply. Contact Nortel support for further information.

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### Application access points

An access point is used by an application to define the ATM network access. It is linked to the connected endpoint of the ATM network. For switched Media Gateway using ATM, the *Nsta Vgs AtmTConn* component and the *Nsta Vgs Ctrl* component are examples of applications that use access points. For non-switched Media Gateway using ATM, the *Nsta Conn* component, is an example of applications that use access points.

To use PSVCs, applications use a switched access point that can be either an active access point (AAP) or a passive access point (PAP).

The AAP of an application defines PSVC connectivity information and generates PSVC calls to the destination application through the ATM network. It is the ATM connection's calling end. The PAP of an application defines the ATM access information and receives the calls from the source. It is the ATM connection's called end. The figure [Active access point and passive access point for ATM PSVCs \(page 121\)](#) shows this relationship.

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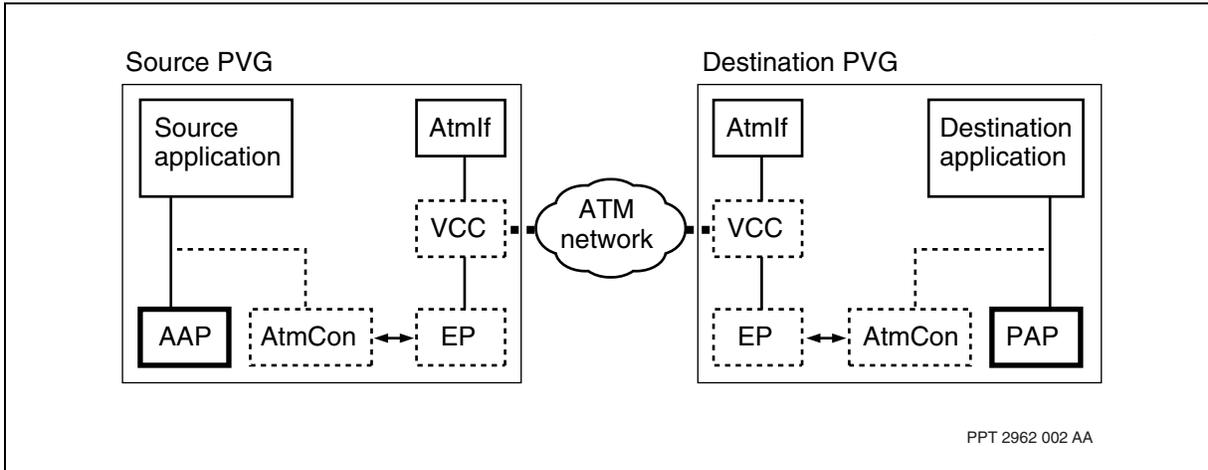
**Attention:** The AAP of an application can also receive a call. However, the PAP of an application can never generate a call. Connections from an AAP to an AAP are not currently supported.

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Once the ATM connection is established, the applications on both ends are linked through *atmConnection (atmCon)* components and *EndPoint (EP)* components. The *EP* components are subcomponents of a dynamic VCC

under the ATM interface at each end of the connection. The *atmCon* components are dynamic operational components and are linked to both *EP* components. The *atmCon* components act as a dynamic bridge for the applications.

### Active access point and passive access point for ATM PSVCs



### ATM signaling

MG establishes, maintains, and clears ATM PSVCs by using three types of ATM signaling messages:

- SETUP, to request the establishment of a connection
- CONNECT, to show that a connection has been established
- RELEASE, to clear a connection

For additional information on ATM signaling, see *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702).

### ATM call processing for non-switched and switched MG using ATM

To originate and terminate PSVC calls, the MG applications at both ends of a connection must have ATM addresses. See [ATM network addressing \(page 124\)](#) for more details.

For non-switched MG using ATM, the MG application is the *Nsta Connection (Conn)* component, for the AAL2 VCCs.

For switched MG using ATM, the MG applications are

- the *Nsta Vgs ControlConnection (Ctrl)* component, for the AAL5 VCC carrying control information

- the *Nsta Vgs AtmTrunkConnection (AtmTConn)* component, for the AAL2 VCCs carrying bearer traffic

For the AAL5 VCCs, the *Aap* subcomponent of the *Ctrl* component has two provisioned attributes related to call processing: *localAddress* and *addressToCall*. The *localAddress* attribute specifies the MG application's unique ATM address. The *addressToCall* attribute specifies the remote end's ATM address. For switched MG using ATM, the remote end may be a router. Furthermore, the router may be spared. The *addressToCall* attribute can contain up to three remote addresses.

Even if the *addressToCall* attribute contains more than one remote address, the PSVC call remains a point-to-point connection. When the calling end prepares the SETUP message, it specifies only the first remote address. The calling end uses the second remote address in a SETUP message only when a call fails, or if an established PSVC fails, and the application receives AIS or RDI fault indication. Otherwise, the calling end continues to use only the first remote address in its SETUP message.

The *Pap* subcomponent of the *Ctrl* component has a *localAddress* attribute and an *expectedRemoteAddress* attribute.

When the called end receives a PSVC call, it is terminated on the local *Ctrl* component with a *localAddress* that matches the called address in the received SETUP message and an *expectedRemoteAddress*, if it is provisioned, that matches the calling address in the received SETUP message. See also [Additional call processing details \(page 124\)](#).

For AAL2 VCCs, the MG application needs to establish many connections to remote ATM end points. Because of this, the individual connections are specified by the remote address, and a unique identifier called a virtual channel connection identifier (VCCI).

Each *AtmTConn* component is automatically associated with the *gatewayAtmAddress* of its parent *Vgs* component. As well, each *AtmTConn* component has a provisioned *remoteAddress* and a *vcci* attribute. So, each *AtmTConn* component has a local address (from the parent VGS *gatewayAtmAddress* attribute), a remote address and a VCCI.

A *Vgs* component can have some *AtmTConn* subcomponents that have the same VCCI, but different remote addresses. The combination of remote address and VCCI must be unique across *AtmTConn* components within the same *Vgs* component.

When the called end receives a PSVC call, it is terminated on the local *AtmTConn* component with a *remoteAddress* and a *vcci* attribute that both match the calling address and VCCI in the received SETUP message.

### ATM call processing for switched MG using IP

To originate and terminate PSVC calls, the MG applications at both ends of a connection must have ATM addresses. See [ATM network addressing \(page 124\)](#) for more details.

For switched MG using IP, the MG applications are

- the *Nsta Vgs ControlConnection (Ctrl)* component, for the AAL5 VCC carrying control information
- the *Nsta Vgs IpMediaStreamConnection (IpMConn)* component, for the AAL5 VCCs carrying bearer traffic

The *Aap* subcomponents of the *Ctrl* and *IpMConn* components each have two provisioned attributes related to call processing: *localAddress* and *addressToCall*. The *localAddress* attribute specifies the MG application's unique ATM address. The *addressToCall* attribute specifies the remote end's ATM address. For switched MG using IP, the remote end is a router that may be spared. The *addressToCall* attribute can contain up to three remote addresses.

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**Attention:** Depending on the level of ILMI that the router supports, additional restrictions on router sparing may apply. Contact Nortel support for additional information.

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Even if the *addressToCall* attribute contains more than one remote address, the PSVC call remains a point-to-point connection. When the calling end prepares the SETUP message, it specifies only the first remote address. The calling end uses the second remote address in a SETUP message only when a call fails, or if an established PSVC fails, and the application receives AIS or RDI fault indication. Otherwise, the calling end continues to use only the first remote address in its SETUP message.

The *Pap* subcomponents of the *Ctrl* and *IpMConn* components each have a *localAddress* attribute and an *expectedRemoteAddress* attribute.

When the called end receives a PSVC call, the call is terminated on the application with a *localAddress* that matches the called address in the received SETUP message and an *expectedRemoteAddress*, if it is provisioned, that matches the calling address in the received SETUP message. See also [Additional call processing details \(page 124\)](#).

### **Additional call processing details**

An MG application with an *Aap* component can set up outgoing calls and receive incoming ATM calls. During PSVC call establishment, the *Aap* component behaves as follows:

- As soon as an incoming or outgoing call is established, all other outgoing call attempts stop and incoming calls are rejected.
- Calls are processed sequentially. A new incoming call is processed once the call before it has been rejected.
- While an outgoing call is in progress, an incoming call is accepted only if the calling party address has a lower value than the called party address. The application end with the higher address becomes the passive end for the call during a call collision.
- If the calling party number is not included in a received SETUP message, priority is given to the outgoing call.
- If both ends are active and provisioned with different parameters, Media Gateway uses the parameters in the end that successfully sets up the call. Parameters from the other end are ignored.

### **Additional call processing details for AAL5 VCCs**

MG provides a filter for incoming SETUP messages for PSVCs with the *expectedRemoteAddress* attribute of the *Aap* and *Pap* components.

- If the *expectedRemoteAddress* attribute is empty, the *Aap* or *Pap* component processes incoming connection requests from any remote address.
- If the *expectedRemoteAddress* attribute is provisioned with an address that is 40 characters long, the connection is set up only if the remote address in the incoming SETUP message exactly matches the one that is provisioned.
- If the *expectedRemoteAddress* attribute is provisioned with an address that is less than 40 characters long, the connection is set up only if the remote address in the incoming SETUP message begins with the characters that are provisioned.

## **ATM network addressing**

ATM network addressing is a 20-byte network service access point (NSAP) address. It consists of a 13-byte prefix and a 7-byte end system identifier (ESI). Nortel Multiservice Switch ATM network addressing is explained in detail in *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – ATM Routing and Signalling* (NN10600-702).

For MG, the address prefix is determined by the *nodePrefix* attribute from the Multiservice Switch shelf. MG applications are assigned addresses with the same prefix but with different ESI. For MG, the *Nsta Vgs AtmTConn* component and the *Nsta Vgs Ctrl* component are examples of applications.

For details on ATM network addressing, see

- [Network addresses for the Vgs component \(page 125\)](#)
- [Network addresses for the Ctrl component \(page 125\)](#)
- [Network addresses for the IpMConn component \(page 125\)](#)
- [Network addresses for the AtmTConn component \(page 126\)](#)
- [Network addresses for the Conn component \(page 126\)](#)

### **Network addresses for the *Vgs* component**

Switched MG using ATM assigns a network address to each VSP2/VSP3/VSP3-o FP card. The address is stored in the *gatewayAtmAddress* attribute of the relevant *Nsta Vgs* component.

Switched MG using IP also assigns a network address to each VSP2/VSP3/VSP3-o FP card in a similar way.

See *Nortel Multiservice Switch 7400/15000/20000 Components Reference* (NN10600-060) for a description of the network address.

### **Network addresses for the *Ctrl* component**

Switched MG using ATM assigns a network address to each *Nsta Vgs Ctrl* component. The address is stored in the *localAddress* attribute of the relevant *Aap*, *Pap*, or *SpvcAp* subcomponent.

Switched MG using IP assigns a network address to each *Nsta Vgs Ctrl* component in a similar way.

See *Nortel Multiservice Switch 7400/15000/20000 Components Reference* (NN10600-060) for a description of the network address.

### **Network addresses for the *IpMConn* component**

Switched MG using IP assigns a network address to each *Nsta Vgs IpMConn* component. The address is stored in the *localAddress* attribute of the relevant *Aap*, *Pap*, or *SpvcAp* subcomponent.

See *Nortel Multiservice Switch 7400/15000/20000 Components Reference* (NN10600-060) for a description of the network address.

### Network addresses for the *AtmTConn* component

Each *AtmTConn* component is automatically associated with the *gatewayAtmAddress* of its parent *Vgs* component, which is used as a local ATM network address.

### Network addresses for the *Conn* component

Non-switched MG using ATM assigns a network address to each *Nsta Conn* component. The address is stored in the *localAddress* attribute of the relevant *Aap*, *Pap*, or *SpvcAp* subcomponent.

See *Nortel Multiservice Switch 7400/15000/20000 Components Reference* (NN10600-060) for a description of the network address.

### Optional components for the *Vgs* component

Up to 25 CAS profiles can be defined through the optional component *CasDefn/n*. Each *CasDefn* component is provisioned with the attribute *fileName*. The *CasDefn* maintains the status on the transfer from CP as an operational attribute *fileTransferStatus*, which indicates: in-progress/complete/missing/fileTooLong/fileError/cpNotResponding. If the FP does not CP respond, or the CP's disks are busy or locked, the *fileTransferStatus* indicates 'cpNotResponding'. If the specified file is missing, the *fileTransferStatus* will indicate 'missing'. If the file size is greater than the allocated file size (20k octets), transfer is rejected and the *fileTransferStatus* indicates 'fileTooLong'. If the length of a file or the timestamp changes during transfer, the transfer is aborted and the *fileTransferStatus* is set to 'fileError'.

The *Cas* component represents the capability to terminate, process and redirect any CAS information associated with the parent *Tag* component. *Tags* provisioned for supporting CAS signaling are enabled once their profile is available.

Any changes to the profile in use by a particular *Tag* during a call either by re-provisioning *CasDefn fileName* or, changing the *Tag* to link to a different *CasDefn* will disable the *Tag*, with a status = 'casNotReady'. This applies to all *Tags* which are associated with this change. This action is reported to the MGC as per standard H.248 ServiceChange (forced) procedures. Once the downloaded profile is available, *Tags* associated with the profile are enabled.

### **Cas**

This attribute specifies the type of standard framing used at the TDM interface. All *CasDefn* components, under the same *Vgs* hierarchy, must have the same value provisioned for this attribute. The possible values are:

- ds1 - TDM interfaces associated with this *CasDefn* component are compliant to the DS1 standard. CAS signaling transport using DS1 Robbed-Bit Signaling is used.

- e1 - TDM interfaces associated with this CasDefn component are compliant to the E1 standard. CAS signaling transport uses timeslot 16.

Default value: ds1

### **CasDefn**

This component represents a CAS profile used on the MG. This attribute specifies the name (without path or extension) of the file that contains the specific CAS variant.

Changing the value of this attribute triggers the transfer of the file from the CP to the VSP FP, and clears down any existing CAS trunks associated with this CasDefn component.

### **Tag**

This attribute indicates the status of a Tag. The status 'casNotReady' indicates that the operationalState of the *CasDefn* component linked to by the Cas subcomponent of this *Tag* is currently disabled.

## **Monitoring alarm signals and indications**

MG applications can detect and react to ATM alarm indication signal (AIS) and remote defect indication (RDI) conditions. Both AIS and RDI indications can be received from the ATM network and processed by the relevant Media Gateway application.

When a MG application receives an AIS or RDI indication from the ATM network:

- and only one remote address is provisioned, the MG application does not release the failed PSVC or SPVC. Instead, the application is disabled and re-enabled after the AIS or RDI condition is cleared.
- and many remote addresses are provisioned, the MG application tears down the failed PSVC or SPVC and establishes a new PSVC or SPVC with the next remote address on the list. The retry mechanism is described in [Retry mechanism \(page 128\)](#). During this time, the MG application uses a hold-off process to accommodate any CONNECT messages that may arrive from the MGC.

While establishing a new PSVC or SPVC, a MG application waits 2.5 seconds to determine if AIS or RDI conditions exist.

If AIS or RDI conditions do not exist, the MG application is enabled.

If AIS or RDI conditions do exist:

- and the indication comes from a PAP, the MG application is not enabled.

- and the indication comes from an AAP or SPVC access point with many provisioned remote addresses, the MG application releases the PSVC or SPVC and tries to establish a new connection to an alternative address.
- and the indication comes from an AAP or SPVC access point with only one provisioned remote address, the MG application accepts the connection and the AIS and RDI conditions are noted.

## Retry mechanism

If an attempt to make an ATM call fails or an established ATM connection is released, the MG application with the AAP or the SPVC access point uses a retry mechanism to attempt to establish a new ATM connection.

The retry mechanism is used when a MG application with an AAP or SPVC access point receives

- a RELEASE message
- an AIS or RDI indication and more than one remote address is provisioned

If the retry mechanism is started due to receipt of a RELEASE message, the first retry address is the current failed address. If the retry mechanism is started due to receipt of an AIS or RDI indication and more than one remote address is provisioned, the first retry address is the address after the current failed address.

The retry mechanism tries each address once before moving on to the next one. There is no waiting time between these two attempts.

Once all the addresses in the remote address list have been tried, a retry round counter is incremented. The *retryLimit* attribute of the *Aap* and *SpvcAp* components specifies the maximum number of unsuccessful retry rounds. If the retry limit is reached, the *Aap* or *SpvcAp* component generates an alarm and further attempts must be manually started with the *restart* command.

The *restart* command applies only to the *Aap* and *SpvcAp* components. See *Nortel Multiservice Switch 7400/15000/20000 Commands Reference* (NN10600-050) for a description.

If the *retryLimit* attribute is provisioned with the value of zero, retry attempts continue indefinitely until a successful connection is established.

The *retryFailures* attribute of the *Aap* and *SpvcAp* components stores the number of consecutive retry rounds that have failed. The number is reset when the retry sequence is restarted.

Each retry round is separated by a retry interval. Following an unsuccessful retry round, the retry interval is incremented. The amount it is incremented as well as its maximum value depends on the parent of the *Aap* or *SpvcAp* component. See the following sections for details:

- [Retry interval for \*AtmTConn\* components \(page 129\)](#)
- [Retry interval for \*Ctrl\* or \*IpMConn\* components \(page 129\)](#)

For dynamically created SVCs, the endpoint which initiated the connection attempts to re-establish the connection up to a maximum of 5 seconds.

### Retry interval for *AtmTConn* components

For the Switched ATM Connection type (SATCON), the retry interval for each *AtmTConn* component is initially set to 0.5 seconds. The retry interval is increased by 0.1 seconds for every RELEASE message that is received, up to its maximum. The maximum is determined by the following formula:

$$\text{maximum interval} = 0.5 + 0.1 \times \text{<dis\_AtmTConn>}$$

where:

<dis\_AtmTConn> is the number of disabled *AtmTConn* components

For example, if there is only one *AtmTConn* component that provisioned and disabled, the initial retry interval is 0.5 seconds and the maximum is 0.6 seconds.

If there are ten *AtmTConn* components that provisioned and six are disabled, the initial retry interval is 0.5 seconds and the maximum is 1.1 seconds.

The retry interval is reset to 0.5 seconds when the VCC is re-established.

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**Attention:** For the Non-Switched ATM Connection type (NSATCON), there is not a limited value for the RetryTimeout interval. Every retry causes the RetryTimeout variable to increment 100 ms and the number of disabled atmConn components are not considered.

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### Retry interval for *Ctrl* or *IpMConn* components

The retry interval for each *Ctrl* or *IpMConn* component is initially set to 2 seconds. The retry interval is increased by 2 seconds every time a connection attempt is made and fails, up to a maximum of 600 seconds.

For example, if the *retryLimit* attribute is set to 5, the initial retry interval is 2 seconds and increases to 12 seconds before the retry limit is reached, the *Aap* or *SpvcAp* component generates an alarm and further attempts must be manually started with the *restart* command.

The retry interval is reset to 2 seconds when the VCC is re-established.

## Behavior on CP switchover

During a CP switchover, a state change indication notifies the MG applications of the event. Attempts to originate new ATM calls are suspended until the MG application receives another state change indication that the CP switchover is complete.

During a CP switchover, trunks that are already established are maintained and ATM calls that are being established proceed as usual.

## On-switch PSVC loops

Two Media Gateway applications can be created on the same VSP/VSP2/VSP3/VSP3-o FP and place calls to create a PSVC to each other, creating an on-switch loop. One application contains an *Aap* subcomponent and acts as the calling end. The other application contains a *Pap* subcomponent and acts as the called end.

However, an application is not allowed to originate and terminate calls to itself. This applies to the AAL5 VCC for control information for switched MG using ATM.

This applies also to the AAL5 VCCs for bearer traffic and the AAL5 VCC for control information for switched MG using IP.

For AAL2 VCCs carrying bearer traffic for switched MG using ATM, an *AtmTConn* component can call another *AtmTConn* component that is part of the same parent VGS, even though both share the same local address. The distinction is that they are assigned different VCCIs. The PSVC call can be accepted when the received VCCI is different from the assigned VCCI.

Because there may be many AAL2 loops on a single VSP, the AAP and PAP are added in pairs with the AAP on one end and the PAP on the other end. In this situation, the VCCI must have adjacent values. The VCCI with the lowest value must be even-numbered and assigned to the AAP.

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# Installing and setting up Media Gateway

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Before you configure the Media Gateway (MG), you must be familiar with Nortel Multiservice Switch network operations and maintenance, and with provisioning commands. See the following documents before you configure MG:

- *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550) provides background and descriptive information and procedural for operating and maintaining Multiservice Switch nodes.
- *Nortel Multiservice Switch 7400/15000/20000 Commands Reference* (NN10600-050) provides information about provisioning commands.

The system requirements for MG are listed in [System requirements for MG \(page 131\)](#).

The prerequisites for configuring MGs on a Multiservice Switch node are

- [Installing Multiservice Switch hardware \(page 132\)](#)
- [Commissioning the node for MG \(page 132\)](#)
- [Installing MG software \(page 133\)](#)
- [Configuring logical processor types for MG \(page 138\)](#)
- [Configuring logical processor for MG \(page 139\)](#)
- [Configuring function processors for MG \(page 139\)](#)

## System requirements for MG

To configure MG, you must install a Nortel Multiservice Switch node that contains the following:

- at least one VSP or VSP2 in Multiservice Switch 7400 nodes, or one VSP2, VSP3, VSP3-o, or 2pVSP4e in Multiservice Switch 15000 nodes.

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**Attention:** You must install either the VSP3-o or 2pVSP4e FP hardware for MG IPsec capability.

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**Attention:** On Multiservice Switch 15000 nodes, 1:1 and 1:N sparing of the VSP2 and VSP3 FP cards can be done where the maximum value of N is 13. The VSP3-o FP card supports 1:1 sparing. The 2pVSP4e FP card supports 1:1 and 1+1 sparing. Sparing must be performed on the same type of VSP (for example sparing between VSP2 and VSP3 is not supported).

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- at least one TDM FP card (not required for optical TDM interface of the VSP3-o or 2pVSP4e FP card)
- at least one ATM FP card or one 4-port gigabit Ethernet FP card (except when using the gigabit Ethernet interface of the VSP3 FP card)
- at least one ATM line or one IP line to connect the node to an ATM/IP device or network
- at least one TDM line to connect a TDM FP card (or the optical TDM interface of the VSP3-o or 2pVSP4e FP card) to a narrowband node or TDM network

In addition to the Multiservice Switch base software, you must install the following:

- Multiservice Switch MG software
- networking software (switched mode only)
- atmNetworking software (switched mode only)

Lastly, for switched MG using ATM and switched MG using IP, you need an ATM connection to a router that provides an IP connection to the media gateway controller (MGC).

## Installing Multiservice Switch hardware

Before you configure MG, you must physically install the Nortel Multiservice Switch node, including the processor cards, termination panels, and cabling. You must also connect a VT-100 or similar terminal to the CP. Follow the procedures in *Nortel Multiservice Switch 7400 Installation, Maintenance, and Upgrade – Hardware* (NN10600-175) or *Nortel Multiservice Switch 15000/20000 Installation, Maintenance, and Upgrade – Hardware* (NN10600-130).

## Commissioning the node for MG

Nortel Multiservice Switch allows a network operator to configure and maintain the Multiservice Switch network using a set of operator commands on a VT-100 terminal. However, you can also use a network management system to configure and maintain your network.

After you install the hardware, run StartUp to configure the control processor(s), connect your node to the rest of your network, and connect to a network management system. See *Nortel Multiservice Switch 7400/15000/20000 Administration – Network Management Connectivity* (NN10600-271) for further instructions.

You can use Nortel Multiservice Data Manager to manage Multiservice Switch nodes. Run StartUp to connect to Multiservice Data Manager. Then see *Nortel Multiservice Data Manager Configuration—Tools* (NN10470-023).

**Attention:** This chapter and the rest of this guide provides instructions based on the command line interface that a VT-100 or similar terminal uses.

## Installing MG software

Use the procedures in *Nortel Multiservice Switch 7400/15000/20000 Installation – Software* (NN10600-270) to install MG software. Before you can configure Multiservice Switch MG, you must install the appropriate software, for each type of MG, on your CP.

### Application and feature for installing MG software

Application or feature	Non-switched MG	Switched MG using ATM	Switched MG using IP
avList	base, mg, aal1Ces	base, aal1Ces, mg, atmNetworking	base, mg, atmNetworking
Lpt/ATM	atmCore	atmCore, atmUni, atmIisp, atmPnni	atmCore, atmUni, atmIisp, atmPnni
Lpt/TDMDS3 or E1 or DS1	nsta	nsta	nsta
Lpt/TDMOC3	aal1Ces	aal1Ces	aal1Ces
Lpt/MG	nsta or pvgG726 or pvgG729 or nsAtmG726 or nsAtmG729		IPSec
Lpt/VGS		VgsAtm or VgsAtmG729 or VgsAtmDc	Vgslp or VgslpG729 or VgslpGigE or VgslpG729GigE

(1 of 3)

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**Application and feature for installing MG software**

Application or feature	Non-switched MG	Switched MG using ATM	Switched MG using IP
Lpt/vgsIP			vgsIP or vgsIPG729 ip atmMpe ipCos ipDiffServ  <b>Attention:</b> Features ipCos and IpDiffServ are not required for VoIP using Ethernet transport and VR configuration (uses default DiffServ functionality).
(2 of 3)			

**Application and feature for installing MG software**

Application or feature	Non-switched MG	Switched MG using ATM	Switched MG using IP
Lpt/vgslpRtoCdma			<p>vgslpRtoCdma, ip, atmmp, aps, and dlep</p> <p><b>Attention:</b> TrFO and RTO modes are not supported simultaneously on the same VSP.</p> <p><b>Attention:</b> This feature is only supported on the 2pOC3ChSmlrVsp3 FP (NTHW77AA), 2pOC2ChSmlrVsp4e (NTHW26AA) FP and 2pVSP4e FP cards.</p>
Lpt/vgslpTrFO			<p>vgslpTrFO, ip, atmmp, aps, and dlep</p> <p><b>Attention:</b> TrFO and RTO modes are not supported simultaneously on the same VSP.</p> <p><b>Attention:</b> This feature is only supported on the 2pVS, (NTHW78AA), 2pOC3ChSmlrVsp3 FP (NTHW77AA), 2pOC2ChSmlrVsp4e (NTHW26AA) FP and 2pVSP4e FP cards.</p>
(3 of 3)			

## IPSec for switched MG call control connections in Carrier VoIP networks

Internet Protocol security (IPSec) is a standard for implementing security measures at the IP level. IPSec for switched MG using IP in a Carrier VoIP Network provides a secure call control connection between a MG with VSP3-0 or 2pVSP4e FPs running VoIP and the Media Gateway Controller (MGC) employing the H.248 call control protocol in Succession Networks.

- or 2pVSP4e

IPSec services supports encapsulating security payload (ESP) using transport mode, which along with key management, help to secure MG communication in the network. ESP can provide the following features:

- data origin authentication
- connectionless integrity
- anti-replay service
- limited traffic flow confidentiality

### Security policies

Security policies (SPs) determine what security services are applied to specific OAM traffic. All security policies are contained within the security policy database (SPD). In the case of IPSec for MG, the SP is applied to all IP traffic flowing between the MG and MGC. What happens once the SP is applied depends on the selector associated with the packet and how it relates to the SPD. Selectors define what criteria are used in determining how IP security protocols are applied to a given packet.

You provision the handling of packets by the SP by choosing one of the following selectors:

- *Bypass*. The packet passes through the call control connection without security being applied.
- *Discard*. The packet is discarded.
- *Apply*. The packet is secured by applying the IPSec protocol defined in the associated SA.

### Security associations

A Security Association (SA) is a logical connection between two peers in a network. An SA provides security services to the traffic for which it has been specified to secure. SAs are established by negotiating certain security parameters between the peers that are defined by the associated policy entry in the SPD. The SA identifies the packet flow and the security protocols applied to that flow.

In the case of IPSec for MG, IPSec SAs are supported. These SAs are negotiated with the peer by using IKE phase 2. The attributes that specify the treatment of the flow and the time to live for the SA are negotiated.

IPSec for the OAM connections between an MDM workstation and an Multiservice Switch 15000 is supported by the following:

- manual SAs
- IKE with pre-shared keys
- IKE with PKI

### **IKE policy**

Internet Key Exchange (IKE) protocol manages the required keys for authenticating or encrypting the IPSec security algorithms. Since MG is using IKE for security associations (SAs) and key renewal, the option of anti-replay protection on incoming packets is supported. The pre-shared keys are symmetric shared private keys that can only be provisioned on VSP cards on both the MG and MGC under the *IkePolicy* component.

You provision the IKE policy by performing the following tasks:

- Choosing the *remotepAddress* selector. The value for this selector is the IP address of the peer security system. For example, the IP address of the MGC with which the *Ctrl/mg* subcomponent is trying to connect.
- Provisioning the *IkeProposal* component and the *IkeTransform* subcomponent. The *IkeProposal* components represent the security parameters to be negotiated between the MC and MGC while the *IkeTransform* subcomponent represents information contained in the transform payload that is used during negotiation of the IKE SA.
- Provisioning the pre-shared key.

For more information on IPSec configuration procedures, see *Nortel Media Gateway 7480/15000 Switched Service Configuration Management* (NN10600-782).

### **IKE phase 1**

IKE phase 1 is the location where the Internet Security Association Key Management Protocol (ISAKMP) peers (MG and MGC, in this case) establish a secure and authenticated channel for communication. This channel is called the ISAKMP security association (SA). Once initialized, IKE has its own security association. The attributes that specify the treatment of the flow and time to live for the IKE SA are negotiated.

IPSec for switched MG call control connections supports main mode for accomplishing IKE phase 1 exchanges.

## IKE phase 2

IKE phase 2 is the location where security associations are negotiated on behalf of IPSec. In this phase, keying material is passed between MC and MGC and also the methods of securing the SA and duration of time to live are negotiated. At the end of a IKE phase 2 exchange, IPSec SAs are created for inbound and outbound traffic. The inbound and outbound IPSec SAs each have a different key.

IPSec for switched MG call control connections supports quick mode for accomplishing IKE phase 2 exchanges.

For procedures on how to verify IKE phase 1 and 2 connection problems, see *Nortel Media Gateway 7480/15000 Switched Service Configuration Management* (NN10600-782).

## Echo canceller options for Multiservice Switch 7400 with VSP

MG with the VSP FP on Nortel Multiservice Switch 7400 nodes, has two echo canceller options. One echo canceller option supports 576 DS0 time slots per VSP. To provision this echo canceller option, provision the feature as *nsta* for the logical processor type (LPT) *12mVspAal*. For a previously-installed MG on the node that requires support for a capacity of 720 DS0 time slots per VSP, use the second echo canceller option. To provision the second echo canceller option, provision the feature as *pvgG726* for the logical processor type (LPT) *12mVspAal* and make sure the echo canceller is disabled; that is, the attribute *echoCancellation* set as *disabled*.

## Configuring logical processor types for MG

After you install the appropriate software on the node, you must configure the LPTs for MG. Follow the procedures in *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550) or *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551).

Configure the following logical processor types (LPTs):

- Create an ATM LPT. For switched MG using ATM, set its *featurelist* attribute to *atmCore*. For switched MG using IP, set its *featurelist* attribute to *ip atmMpe*.
- Create an NSTA LPT and set its *featurelist* attribute to *nsta*.
- Add IPSec to the MG LPT associated with a VSP3-o or 2pVSP4e card, if you want to activate IPSec for switched MG using IP.
- Create a VGS LPT. For switched MG using ATM, set its *featurelist* attribute to *vgsAtm*. For switched MG using IP, set its *featurelist* attribute to *vgsIP*.
- For the 4-port OC-3/STM-1Ch TDM/CES FP create an OPTTDM LPT and set its *featurelist* attribute to *aal1ces*.

## Configuring logical processor for MG

After you install the LPTs on the node, you must configure the LPs for MG. Follow the procedures in *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550) or *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551).

Configure the following logical processor (LPs):

- Create an LP for the ATM interface:
  - Set its *maincard* attribute to the ATM FP card for switched MG using ATM, or set its *maincard* attribute to the IP service card for switched MG using IP.
  - Set its *lpt* attribute to *lpt/ATM*, as defined earlier.
- Create an LP for voice services:
  - Set its *maincard* attribute to the voice services FP in the shelf.
  - Set its *lpt* attribute to *lpt/VGS*, as defined earlier.
- Create an LP for the TDM interface (not required for optical TDM interface of the VSP3-o FP card):
  - Set its *maincard* attribute to the TDM FP in the shelf.
  - for the 32-port E1 and 2-port DS3 TDM FPs set its *lpt* attribute to *lpt/NSTA*, as defined earlier.
  - for the 4-port OC-3/STM-1Ch TDM/CES FP set its *lpt* attribute to *lpt/OPTTDM*.

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**Attention:** OPTTDM is used to distinguish the features for the optical TDM FP. OPTTDM is the name that you used to define the featurelist for the 4-port OC-3/STM-1Ch TDM/CES FP in the section [Configuring logical processor types for MG \(page 138\)](#).

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## Configuring function processors for MG

After you configure the LPs on the node, you must configure the FPs. Follow the procedures in *Nortel Multiservice Switch 7400/15000/20000 Configuration* (NN10600-550) or *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551).

Configure the FPs as follows:

- for the ATM FP:
  - Set the card's *cardtype* attribute to the appropriate value, for example *12pDS3Atm*.

- Add to the associated LP any required interface components. For example, for an 12-port DS3 ATM FP, you would add *DS3* components under the *Lp* component.
- for the IP service FP:
  - Set the card's *cardtype* attribute to the appropriate value, for example *4pGe*.
  - Add to the associated LP any required interface components. For example, for an 12-port DS3 ATM FP, you would add up to four ports using the *ethernet* components under the *Lp* component.
- for the voice services FP:
  - Set the card's *cardtype* attribute to the appropriate value, for example *12mVspAal*.
  - Add to the associated LP a *vsp* component.
- for the TDM FP:
  - Set the card's *cardtype* attribute to the appropriate value, either *2pDS3cAal*, *32pE1Aal*, or *4pOC3ChSmlr*.
  - Add to the associated LP any required interface components. For example, for an 2-port DS3C TDM, you would add *DS3* and *DS1* components under the *Lp* component.

For switched MG using IP, Nortel Networks recommends that the ATM FP be either DS3 or OC-3 to provide the necessary bandwidth. As well, the *linetype* attribute of each *DS1* component must be set to *esf*.

After you configure the LPTs, the LPs and the FPs, ensure that you activate and confirm the provisioning.

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# Traffic management for Media Gateway

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Different types of traffic have unique traffic characteristics (in terms of rate and density variation) and performance needs (in terms of delay and loss). Media Gateway (MG) supports different types of traffic over the ATM link. You must provision the service for each link in accordance with the traffic contract between the service provider and the subscriber. Effective traffic management satisfies the quality of service (QoS) requirements for each subscriber and manages network resources so that the service offering is cost-effective.

For MG, the service requirements of each subscriber translate into an ATM service category and traffic descriptor type and parameters for each VCC link. You must allocate an appropriate amount of bandwidth and priority to each service so that the delivered services meet the traffic contract during both normal operation and when links are congested.

If voice-band connection admission control (V-CAC) is not used, see the following sections for more information:

- [Configuring ATM traffic management \(page 142\)](#)
- [Determining values for ATM cell rates for non-switched MG \(page 143\)](#)
- [Determining congestion thresholds \(page 145\)](#)
- [Adjusting hold-over time \(page 145\)](#)
- [Adjusting PDVT and buffer size \(page 147\)](#)
- [Considerations of switched ATM connections \(page 148\)](#)
- [Congestion and overload control for SS7 signaling within the M2UA protocol and VSP card \(page 149\)](#)

If V-CAC is used, see section [Voice-band connection admission control \(page 150\)](#) for more information.

## Configuring ATM traffic management

For each link, you must configure one VCC for each type of traffic. For example, if you want to carry voice with CCS, you need to configure two VCCs. For each VCC, you need to set the following traffic management attributes: *atmServiceCategory*, *txTrafficDescType*, and *txTrafficDescParm*. See the following sections:

- [atmServiceCategory attribute \(page 142\)](#)
- [txTrafficDescType attribute \(page 142\)](#)
- [txTrafficDescParm attribute \(page 143\)](#)

### atmServiceCategory attribute

The *atmServiceCategory* attribute defines the ATM service category for traffic in both directions on the ATM link. For voice and voice band data (fax and modem) calls, *rtVariableBitRate* is the recommended setting. For data such as frame relay, *nrtVariableBitRate* is the recommended setting.

For signaling, you can set the *atmServiceCategory* attribute to *rtVariableBitRate* or *nrtVariableBitRate*. However, if you want to ensure that signaling traffic maintains priority over data traffic during periods of heavy congestion, set the *atmServiceCategory* attribute for the signaling VCC to *rtVariableBitRate*. Signaling can not be set to the same VCC as voice traffic. If voice is set to CBR then signaling may be *rtVariableBitRRate*. If voice traffic is set to *rtVariableBitRate* then signaling must be set to *nrtVariableBitRate*. If you need a VCC for a network management system, set the attribute to *nrtVariableBitRate* or *rtVariableBitRate*. If you want to ensure this traffic maintains priority over data traffic, set the attribute to *rtVariableBitRate*.

---

**Attention:** Setting the *atmServiceCategory* attribute is only one way of establishing priority for traffic. Nortel Multiservice Switch systems allow you to establish bandwidth pools to manage traffic. You can establish up to three pools for each ATM port. For more information, see *Nortel Multiservice Switch 7400/15000/20000 ATM Fundamentals* (NN10600-700).

---

### txTrafficDescType attribute

The *txTrafficDescType* attribute specifies the type of traffic management parameters you can set for the connection. The setting for this attribute determines the number and meaning of the parameters set by the *txTrafficDescParm* attribute. For MG, set this value to 6, 7, or 8.

### txTrafficDescParm attribute

After you set the *txTrafficDescType* attribute to 6, 7, or 8, you can set the values for the peak cell rate (PCR), sustainable cell rate (SCR), and maximum burst size (MBS) for the VCC. Parameter 1 is the value for PCR. Parameter 2 is the value for SCR. Parameter 3 is the value for MBS. You must specify each value as an integer, for example

```
set atmIf/6 vcc/16.32 vcd Tm txTrafficDescParm 1 3620
2 1300 3 2000
```

You can also set the values individually, for example

```
set atmIf/6 vcc/16.32 vcd Tm txTrafficDescParm 2 1300
```

### Determining values for ATM cell rates for non-switched MG

The values you specify for the ATM Peak Cell Rate (PCR), Sustained Cell Rate (SCR), and Maximum Burst Size (MBS) are a function of many factors. For example, for a voice VCC, you must consider the values you have configured for the maximum voice rate, the maximum number of voice calls, and whether or not you have enabled silence suppression. Typical speech patterns for the serviced area also affect traffic levels.

- [Calculating PCR for non-switched MG \(page 143\)](#)
- [Calculating SCR for non-switched MG \(page 144\)](#)
- [Calculating MBS for non-switched MG \(page 145\)](#)

### Calculating PCR for non-switched MG

Generally, the value for PCR is equal to (or is the nearest rounded value) of the link rate. Therefore, for a DS1 TDM link, you can set the PCR to 3622. For an E1 TDM link, you can set the PCR to 4678.

In a multi-service network with link rates of DS3, OC3, and faster calculate PCR for the number of DS0s to be transported. To determine the number of cells per second, see the table [Packet bandwidth requirements \(page 143\)](#).

### Packet bandwidth requirements

CODEC type	Encoding rate	Bandwidth per DS0	Cell/second
G.711	64 kbit/s	77.6 kbit/s	183
G.726	32 kbit/s	38.8 kbit/s	91.5
G.726	24 kbit/s	29.8 kbit/s	70.2
G.726	16 kbit/s	21.7 kbit/s	51.2
G.729A	8 kbit/s	11.7 kbit/s	27.6

Generally, the AAL5 VCC that carries the PRI (CCS) signaling for the MG connection has a PCR value of 300.

### Calculating SCR for non-switched MG

The following calculations for SCR with silence suppression disabled and enabled provide the minimum SCR required to provide the minimum acceptable quality of service when all time slots are active. During less busy periods, the system transports voice calls at the maximum voice rate, therefore delivering a higher quality of service.

The minimum value of SCR is the sum for all channel rates. The result of the calculation must be rounded to the next multiple of 100. Voice traffic, with silence suppression enabled, tends to be bursty therefore, the calculation of SCR differs when silence suppression is enabled or disabled.

- [Calculation of SCR with silence suppression disabled \(page 144\)](#)
- [Calculation of SCR with silence suppression enabled \(page 144\)](#)

### Calculation of SCR with silence suppression disabled

$$\text{SCR} = \frac{(\text{chan\_rate}) * (\text{num\_of\_chan}) * (\text{p\_payload} + 3) * \text{PEAF}}{(\text{p\_payload}) * 8 * (\text{c\_payload})}$$

#### Calculation of SCR with silence suppression disabled variable values

Variable	Value
<chan_rate>	The channel rate.
<num_of_chan>	The number of channels.
<p_payload>	The packet payload.
<PEAF>	The packing efficiency adjustment factor the value is 1.1.
<c_payload>	The cell payload.

### Calculation of SCR with silence suppression enabled

$$\text{SCR} = \frac{(\text{chan\_rate}) * (\text{num\_of\_chan}) * (\text{p\_payload} + 3) * \text{PEAF} * \text{SAF} * \text{BMAF}}{(\text{p\_payload}) * 8 * (\text{c\_payload})}$$

#### Calculation of SCR with silence suppression enabled variable values

Variable	Value
<chan_rate>	The channel rate.
<num_of_chan>	The number of channels.
<p_payload>	The packet payload.
(1 of 2)	

---

**Calculation of SCR with silence suppression enabled variable values (continued)**

Variable	Value
<PEAF>	The packing efficiency adjustment factor.
<SAF>	The speech activity factor. The value of this factor is 0.6.
<BMAF>	The burst margin adjustment factor. The value of this factor is 1.1.
<c_payload>	The cell payload.
(2 of 2)	

**Calculating MBS for non-switched MG**

For a VCC that has no silence suppression for voice traffic, or that has no voice traffic, the traffic stream is smooth. Calculate the minimum value for MBS using the following equation. Round the result up to the nearest multiple of 50.

$$\text{MBS} = 1.2 \times \text{SCR traffic sampling interval (in sec)} \times \text{SCR}$$

For traffic where silence suppression is enabled, set the MBS to 2000, which corresponds to just over half a second of burst.

Generally, the AAL5 VCC that carries the PRI (CCS) signaling for the MG connection has an MBS value of 50.

**Determining congestion thresholds**

Nortel Multiservice Switch MG manages congestion by using a series of thresholds. As traffic levels rise and fall around these thresholds, MG invokes different congestion management measures. The default values for congestion threshold attributes satisfy typical configurations and should be used in most cases. However, there are cases where you can change one or more settings. For example, if you configure the system with silence suppression off (non-switched mode only), set the *scrLowCongThreshold* attribute to 100%.

MG provides semantic checks that prevent you from configuring invalid congestion thresholds. For example, the value for the *pcrHighCongThreshold* attribute must be set higher than the value for the *pcrLowCongThreshold* attribute. However, semantic checks do not prevent you from configuring values that do not work for your configuration.

**Adjusting hold-over time**

Always use caution when you adjust the hold-over time (*holdOverTime* attribute). The hold-over time is the maximum amount of time the system waits before sending a cell onto the ATM link. During periods of low traffic, the hold-over time affects both the system's efficiency in using ATM bandwidth and the end-to-end delay in the system.

As you decrease the hold-over time, the system sends cells onto the ATM link more frequently. During periods of low traffic, many of these cells contain padding. This padding consumes bandwidth that could otherwise be used to transport other types of traffic, for example, frame relay.

Conversely, as you increase the hold-over time, the system transmits cells onto the ATM link less frequently. During periods of low traffic, fewer of these cells contain padding, as it is likely another packet arrives and fills the cell before the hold-over time timer expires. The longer hold-over time increases bandwidth efficiency, but introduces extra delay into the system, which can affect call quality.

The hold-over time has a direct relationship with both SCR and the packet delay variation tolerance at the far end. For more information, see the following sections:

- [Hold-over time and SCR \(page 146\)](#)
- [Hold-over time and PDVT \(page 147\)](#)

### **Hold-over time and SCR**

There is a direct relationship between the settings for the SCR and the hold-over time (*holdOverTime* attribute). If the value you set for the SCR is too low in relation to the hold-over time, the system can detect congestion even during times of low traffic.

When MG compresses voice calls from 32 kbit/s to 24 kbit/s or 16 kbit/s (non-switched mode only), the packet size reduces proportionately, but the rate at which the system generates packets remains constant. Packet sizes are as follows:

- at 32 kbit/s, packets are 40 bytes in length
- at 24 kbit/s, packets are 30 bytes in length
- at 16 kbit/s, packets are 20 bytes in length
- at 8 kbit/s, packets are 10 bytes in length

The packet header adds an additional 3 bytes to each packet.

For PCM voice, the inter-packet arrival time is 5 ms. For ADPCM voice calls, the inter-packet arrival time is 10 ms. This means that when a call is in process, the system generates a packet every 5 ms for PCM voice and every 10 ms for ADPCM voice.

During periods of low traffic, cells usually contain a single packet. There is not enough traffic to fill the cell before the hold-over time timer expires, so the system sends the cell out onto the link. The system pads any space in the cell that the packets do not fill.

For example, if you are using ADPCM voice and the hold-over time is set to 2.0 ms, packets arrive every 10 ms and are sent out at least every 2 ms. Using this scenario, suppose there are five active voice calls. At its most inefficient state, packets can arrive from each voice call at 2, 4, 6, 8, and 10 ms. The system sends each packet across the link (in an ATM cell) as soon as the hold-over timer expires, at 4, 6, 8, 10, and 12 ms, generating traffic at a rate of 500 cell/second.

If the SCR is set below 500 cell/second, the system detects congestion even when it is sending cells that contain a single packet. The system attempts to compress calls to relieve congestion. However, because the cells already contain a single packet, congestion is not relieved. The only difference is that the cells contain more padding because the compressed packets are smaller.

### **Hold-over time and PDVT**

You must set the hold-over time at the near end so that it is compatible with the setting for PDVT (the *pvt* attribute) at the far end. Similarly, the PDVT setting on the near end must be compatible with the hold-over time at the far end.

If you increase the hold-over time without also appropriately increasing the PDVT, buffer underflow can occur. If you decrease the hold-over time without decreasing the PDVT appropriately, buffer overflow (loss of cells) can occur.

### **Adjusting PDVT and buffer size**

There is a direct relationship between the settings for PDVT and the buffer size. If the minimum configured voice rate is 32, 24, or 16 kbit/s ADPCM (non-switched mode only) or 8 kbit/s CS-ACELP, the setting for PDVT on the far end must be twice the inter-packet arrival time plus the expected ATM cell delay variation (CDV). For ADPCM, inter-packet arrival time is 10 ms. Set the PDVT to twice that value, plus ATM CDV—for example, 23 ms.

If the minimum configured voice rate is 64 kbit/s PCM, the setting for PDVT on the far end must also be twice the value of inter-packet arrival time plus the expected ATM CDV. For PCM, inter-packet arrival time is 20 ms. Set the PDVT to twice that value plus ATM CDV—for example, 43 ms.

If you set the PDVT to less than 10 ms, or if the difference between the *bufferSize* attribute and the PDVT is less than 10 ms, buffer underflow can occur. If you configure these types of settings, Nortel Multiservice Switch systems warn you when it checks the provisioning.

## Considerations of switched ATM connections

When provisioning MG to use switched ATM connections, such as provisioned switched virtual connections (PSVCs) or soft permanent virtual connections (SPVCs), you must set the following attributes to specify ATM traffic management parameters:

- `AtmServiceCategory`
- PCR
- SCR
- MBS

For an explanation of how these parameters are used, see

- [ATM service category \(page 148\)](#)
- [Connection admission control \(page 148\)](#)
- [Other parameters \(page 149\)](#)

### ATM service category

For switched MG using ATM

- the *rt-vbr* and *cbr* service categories are available for the AAL2 VCCs carrying bearer traffic.
- the *nrt-vbr* and *cbr* service categories are available for the AAL5 VCCs carrying control information.

For switched MG using IP

- the *rt-vbr* and *cbr* service categories are available for the AAL5 VCCs carrying bearer traffic.
- the *nrt-vbr* and *cbr* service categories are available for the AAL5 VCCs carrying control information.

---

**Attention:** If *cbr* is selected then SCR and MBS must both equal zero and the *cell delay variation tolerance* attribute on the ATM network FP must be set to 59 nanoseconds.

---

### Connection admission control

Connection admission control (CAC) is the procedure used to decide if a request for a connection can be accepted based on the attributes of both the requested connection and the existing connections. Connection admission control looks at the PCR, SCR and MBS of the requested connection as well as at the available capacity of the ATM link.

When establishing a new ATM connection, ATM CAC is invoked on both the source and destination MGs to determine if the requested quality of service is supported and if there is enough bandwidth left on the ATM link to accommodate the new connection without affecting the existing connections.

The congestion threshold for CAC is set by provisioning the *ccsClearDataMaxChannels*, *voicebandDataMaxChannels*, and *ccdTimeslotList* attributes. The *ccsClearDataMaxChannels* attribute specifies the number of CCD calls allowed per ATM VCC with guaranteed quality of service during congestion periods. This attribute is only valid for the CCS and monitored service interfaces. The *voicebandDataMaxChannels* attribute specifies the number of modem and fax calls allowed per ATM VCC with guaranteed quality of service during congestion periods. The *ccdTimeslotList* attribute specifies the number of channels allowed per ATM VCC. The congestion threshold is the upper bound for traffic on the non-switched MG.

### Other parameters

Other parameters include

- cell delay variation tolerance
- per-connection queuing
- traffic shaping
- usage parameter control

These parameters are specified for the entire ATM interface. All switched VCCs of the same ATM interface use the same values for these parameters.

## Congestion and overload control for SS7 signaling within the M2UA protocol and VSP card

MTP2 software and the VSP card use the M2UA protocol to send congestion indications to the MGC when congestion scenarios are detected. The MGC does not send a congestion indications to the MG.

MTP2 software maintains a simple congestion control state machine and uses the status indication "B" (Busy) message signal unit to convey a congestion scenario between the MTP2 software layers. MTP2 layer management notifies the reception control software of a congestion scenario. As a result, the congestion control state machine moves from Idle to the Level 2 Congestion state and a SIB LSSU is sent in response to the next LSSU from the SEP.

Congestion notifications can also be received from the SCTP layer through the 'STATUS CHANGE' message to the M2UA protocol. Congestion is detected on a per endpoint basis according to RFC 2960, Stream Control Transmission Protocol. This allows M2UA/MTP2 layer management to move

a link controlled by one MGC into a 'congested state' and not impact a link controlled by a different MGC whose SCTP link/association is not congested. M2UA passes the congestion information for the links associated with the congested endpoint to the MTP2 software which in turn marks the links as congested. The link state stays In-service and the next MSU that is received from the SEP causes the MTP2 software to send a SIB LSSU to reflect that status of the congested link.

If one of the T6 or T7 timers, started by the receipt of a status indication 'B' LSSU, expires prior to the clearing of the SIB indication, the Q.703 software takes the link down which causes the M2UA Release Indication message to be sent to the MGC. Normal operation on the link continues if the far end resumes operation prior to the timer expiry and sends an acknowledgement.

### **Voice-band connection admission control**

MG ensures that the resources of an external VoAAL2 VCC are not exceeded by ensuring that the number of active voice connections over that VCC does not exceed the provisioned attribute *Nsta/n Vgs AtmTConn/n maxNumberAal2Trunks* for end-point provisioned VCCs or the provisioned attribute *Nsta/n Vgs Aal2SvcService Prof/n maxNumberAal2Trunks* for on-demand generated SVCs. It is up to the user provisioning *maxNumberAal2Trunks* and the ATM parameters of the VCC to ensure that the aggregate ATM bandwidth caused by that number of voice connections, using voice compression as used in that particular network, do not exceed the signalled or provisioned ATM parameters of the VCC.

### **Channel Associated Signaling (CAS) congestion control**

The MG ensures that CAS signaling overload does not occur by ensuring that the:

- BHHCA load does not exceed the specified maximum sustainable BHHCA load. While the offered load is still below twice the specified maximum value, the system does not crash and the throughput shall not degrade to below 70% of the specified maximum load.
- A loss of one or multiple DS1/E1 trunks while the MG is at specified maximum BHHCA load does not cause the loss of stable calls on other trunks.
- A single DS1/E1 with any combination of input ABCD bits does not cause the loss of stable calls on any other DS1/E1. Call setup for any DS0 on other DS1/E1s in the system can not be interrupted for more than 60 seconds.
- A situation where up to 50% of total DS0 capacity is fluctuating between Trunk Conditioning and Idle state with a 5 seconds or longer period cycle, does not cause the loss of stable calls on unaffected DS0s. Full call set-

up capability on unaffected DS0s is restored within 60 seconds from detection of fault condition.

The *Cas* component under *Tag* shall carry an operational attribute *blockedChannels*. This gauges the number of DS0s in the *Tag* blocked, either autonomously or explicitly through MGC action through explicit application of casblk/blk signal. Autonomously blocked means that a) after the SC(restart) but before explicit application by MGC of signal apart from casblk/blk signal, or b) during overload.

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# Fault management for Media Gateway

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Nortel Multiservice Switch systems generate alarms and state change notifications whenever it detects a problem. For general guidelines on troubleshooting Media Gateway (MG), see the following sections:

- [Alarms \(page 152\)](#)
- [Continuity test \(page 153\)](#)
- [Ping \(page 155\)](#)
- [Customer accessible PING \(page 156\)](#)
- [Diagnosing ping failure from the ControlConnection component \(page 160\)](#)
- [Periodic routine exercise for MG15000 \(page 162\)](#)
- [State change notifications \(page 165\)](#)
- [Fault handling for MG \(page 166\)](#)
- [TDM interface faults \(page 166\)](#)
- [ATM interface faults \(page 168\)](#)
- [Buffer underflow faults \(page 170\)](#)
- [Configuring the response to failures \(page 170\)](#)
- [Troubleshooting general MG problems \(page 171\)](#)
- [Troubleshooting local announcements \(page 176\)](#)
- [Troubleshooting PRI backhaul \(page 179\)](#)
- [Troubleshooting SS7 backhaul \(page 180\)](#)
- [Troubleshooting REX \(page 182\)](#)

## Alarms

Alarms indicate faults or failure conditions on a node. A component generates an alarm to indicate that it is in need of repair or has detected a fault elsewhere on the node.

Alarms are an integral part of fault management. The following situations generate alarms:

- degradation/quality of service conditions (for example, the onset of severe congestion)
- processing errors (for example, protocol errors)
- engineering alarms (for example, insufficient memory for a required component)
- out-of-service conditions (for example, hardware failures such as a function processor or power supply failure)
- software errors (that is, an unexpected condition has been detected in software)
- administrative conditions (such as using the lock command to temporarily lock a component)
- security violations (for example, successive invalid login attempts)
- periodic routine exercise (REX) testing on MG15000

Nortel Multiservice Switch alarms include open systems interconnection (OSI) state information. You can use alarm information in combination with the OSI state to determine the cause of a failure. For more information about alarms, see *Nortel Multiservice Switch 6400/7400/15000/20000 Alarms Reference* (NN10600-500). For information about Media Gateway OSI states, see either *Nortel Media Gateway 7480/15000 Non-switched Service Configuration Management* (NN10600-781) or *Nortel Media Gateway 7480/15000 Switched Service Configuration Management* (NN10600-782).

## Continuity test

MG supports continuity test (COT) tones to verify electrical continuity between the MG and the public switched telephone network (PSTN). In response to a command from the media gateway controller (MGC), the MG originates a COT tone towards the time-division multiplexing (TDM) network of PSTN and search for a return tone as a response. The receiving of a responding COT return tone verifies the electrical continuity of the tested path. The MG also terminates a COT tone from the TDM network and sends a COT tone in response. Echo cancellation is disabled for the COT path. The COT return tone is not transmitted towards the packet network. Silence suppression is used if there is an attempt to transmit the COT return tone towards the packet network. A COT timer is used to limit the search time by the MG for a COT return tone. For MG with H.248 control protocol, the COT timer is contained within the MG. The MG rejects any signal requests for simultaneous or concatenated playout of another tone or announcement on the same COT tone path. An unexpected COT return tone of a different frequency is ignored.

MG supports COT tones MG for the following circuit configurations:

- [4-wire COT \(page 154\)](#)
- [2-wire COT \(page 154\)](#)

#### **4-wire COT**

MG supports originating and terminating COT tones on 4-wire circuits for the following:

- voice services processor 2 (VSP2) on Multiservice Switch 7480, Multiservice Switch 15000
- VSP3 FP cards on Multiservice Switch 15000
- voice services processor 3 with optical TDM interface (VSP3-o) and 2 port voice services processor 4e (2pVSP4e) FP cards on Multiservice Switch 15000

In response to a command from the media gateway controller (MGC), the MG originates a 2010 Hz COT tone towards the TDM network and search for a 2010 Hz return tone as a response. The MG also terminates a 2010 Hz COT tone from the TDM network and send a 2010 Hz COT tone in response.

#### **2-wire COT**

MG also supports originating and terminating COT tones on 2-wire circuits for the following:

- VSP3 FP cards when used with the 4-port OC-3/STM-1 Ch TDM/CES FP card (NTHW70) on Multiservice Switch 15000
- voice services processor 3 with optical TDM interface (VSP3-o) and 2 port voice services processor 4e (2pVSP4e) FP cards on Multiservice Switch 15000

MG supports 2-wire COT as follows:

- COT per ANSI T1.113.4 Annex B.2 where both the originating and terminating nodes are 2-wire circuits as follows:
  - In response to command from the MGC, MG originates a 2010 Hz COT and searches for a 1780 Hz tone in response.
  - MG terminates a 2010 Hz COT and responds by sending a 1780 Hz tone.
- COT per ANSI T1.113.4 Annex B.3 transmit low receive high (TLRH) where MG is a 4-wire circuit and the other node is a 2-wire circuit as follows:
  - In response to command from the MGC, MG originates a 1780 Hz COT and searches for a 2010 Hz tone in response.

- MG terminates a 2010 Hz COT and responds by sending a 1780 Hz tone.
- COT per ANSI T1.113.4 Annex B.3 transmit high receive low (THRL) where the MG acts like the 2-wire circuit and the other node is the 4-wire circuit as follows:
  - In response to command from the MGC, MG originates a 2010 Hz COT and searches for a 1780 Hz tone in response.
  - MG terminates a 1780 Hz COT and responds by sending a 2010 Hz tone.

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**Attention:** To interwork the MG with a Nortel Networks DMS switch, use the 4-wire COT configuration or use the 2-wire COT per ANSI T1.113.4 Annex B.3 (TLRH or THRL) configuration. Interworking the MG with a Nortel Networks DMS switch is not supported using the 2-wire COT per ANSI T1.113.4 Annex B.2 configuration.

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MG configures COT at the DS1/E1 level using a provisionable attribute *continuityTestType (cotType)* of component *Nsta Vgs BragS* or component *Nsta Vgs TProf*. COT can be configured as follows:

- attribute *continuityTestType (cotType)* of component *Nsta Vgs BragS* when using the VSP3 FP card with the 4-port OC-3/STM-1 Ch TDM/CES (NTHW70) FP card
- attribute *continuityTestType (cotType)* of component *Nsta Vgs TProf* when using the VSP3-o FP card

## Ping

Ping is a feature to allow a user to prove connectivity from a MG interface that supports IP to another IP address without the need for external equipment. This feature uses a command verb *ping* to send Internet control message protocol (ICMP) echo requests to a specified host. The host is specified by an IP address option of the *ping* command syntax. The MG interface that supports IP is specified by a MG component of the *ping* command syntax. A response message is received to the *ping* command to indicate if it is successful or not. Connectivity is proven when the *ping* command has a successful response.

Ping is supported from the following MG components for VSP2, VSP3, and VSP3-o FP cards:

- component *Nsta/x Vgs Ctrl/mg* on VSP2, VSP3, and VSP3-o FP cards
- component *Nsta/x Vgs Ctrl/sg* on VSP2, VSP3, and VSP3-o FP cards
- component *Nsta/x Vgs IpMConn* on VSP3 and VSP3-o FP cards

- component *Nsta/x Vgs DbgAccess* on VSP3 FP cards

Examples of the *ping* command syntax for each of the MG components are as follows:

- *ping -ip(48.58.33.51) Nsta/4 Vgs Ctrl/mg*
- *ping -ip(48.58.33.51) Nsta/4 Vgs Ctrl/sg*
- *ping -ip(48.58.33.51) Nsta/4 Vgs IpMConn*
- *ping -ip(48.58.33.51) Nsta/4 Vgs DbgAccess*

The ICMP ping messages will be discarded by the IP security (IPSec) feature of MG unless the user configures the IPSec feature to allow ping to bypass the security for both the inbound and outbound directions.

## Customer accessible PING

Customer Accessible *ping* provides proof of connectivity from any of the interfaces supporting IP on the MG, to any IP address without the need for external equipment.

Use of the command verb *ping* sends Internet control message protocol (ICMP) echo requests to a specified host. The host is specified by an IP address option of the *ping* command syntax. The MG interface that supports IP is specified by a MG component of the *ping* command syntax. Connectivity is proven when the *ping* command has a successful response.

If the *ping* is successful, it outputs the following information:

- number of bytes received
- IP address of the responding host
- ICMP sequence number of the received packet
- elapsed time from sending of the *ping* to receiving of the response

The TRACEROUTE option of the *ping* verb identifies the path a packet takes from one MG component to the IP specified. It lists all the routers the packet passes through until it reaches its destination, or fails and is discarded. It also tells how long each hop from router to router takes.

If the *traceroute* option is used and the *ping* is successful, it outputs the following information:

- IP addresses of the responding hosts or \* if there was no response
- elapsed time between sending the *ping* to receiving the response

Ping is supported on the following MG components for VSP2, VSP3, VSP3-o, and 2pVSP4e FP cards:

- component *Nsta/x Vgs Ctrl/mg* on VSP2, VSP3, VSP3-o, and 2pVSP4e FP cards
- component *Nsta/x Vgs Ctrl/sg* on VSP2, VSP3, VSP3-o, and 2pVSP4e FP cards
- component *Nsta/x Vgs IpMConn* on VSP3, VSP3-o, and 2pVSP4e FP cards
- component *Nsta/x Vgs DbgAccess* on VSP3 FP cards

Examples of the *ping* command syntax for each of the MG components are as follows:

- *ping -ip(48.58.33.51) -size(1200) -df Nsta/4 Vgs Ctrl/mg*
- *ping -ip(48.58.33.51) -size(2048) -df -dscp(ef) -continuous Nsta/4 Vgs Ctrl/sg*
- *ping -ip(48.58.33.51) -stop Nsta/4 Vgs DbgAccess*
- *ping -ip(48.58.33.51) -size(2048) -dscp(cs5) Nsta/4 Vgs IpMConn*

Examples of the *traceroute* option of the *ping* command for each of the MG components are as follows:

- *ping -traceroute -ip(48.58.33.51) -size(2048) -df Nsta/4 Vgs Ctrl/mg*
- *ping -traceroute -ip(48.58.33.51) -df -dscp(ef) Nsta/4 Vgs Ctrl/sg*
- *ping -traceroute -ip(48.58.33.51) -size(2048) Nsta/4 Vgs DbgAccess*
- *ping -traceroute -ip(48.58.33.51) -size(1024) -dscp (af11) Nsta/4 Vgs IpMConn*

The command *ping* can be added to the following components:

- *ControlConnection*
- *IpMediaStreamConnection*
- *DebugIpAccess*

### **ICMP Ping from the *ControlConnection* component**

Entering the *ping* command (if the *continuous* option is not present) against the *ControlConnection* component sends one ping message from the connection. The maximum message PDU size is 1472 bytes.

### **ICMP Ping from the *IpMediaStreamConnection* component**

Entering the *ping* command against the *IpMediaStreamConnection* component (if the *continuous* option is not present) sends one ping message from the connection. The maximum message PDU size is 512 bytes.

### ICMP Ping from the *DebugIpAccess* component

Entering the ping command against the *DebugIpAccess* component (if the continuous option is not present) sends one ping message from the connection unless the first ping is not replied to with a correctly formatted ICMP echo response message. The maximum message PDU size is 512 bytes.

The figure [Component ping command behavior](#) shows the behavior of the ping.

#### Component ping command behavior

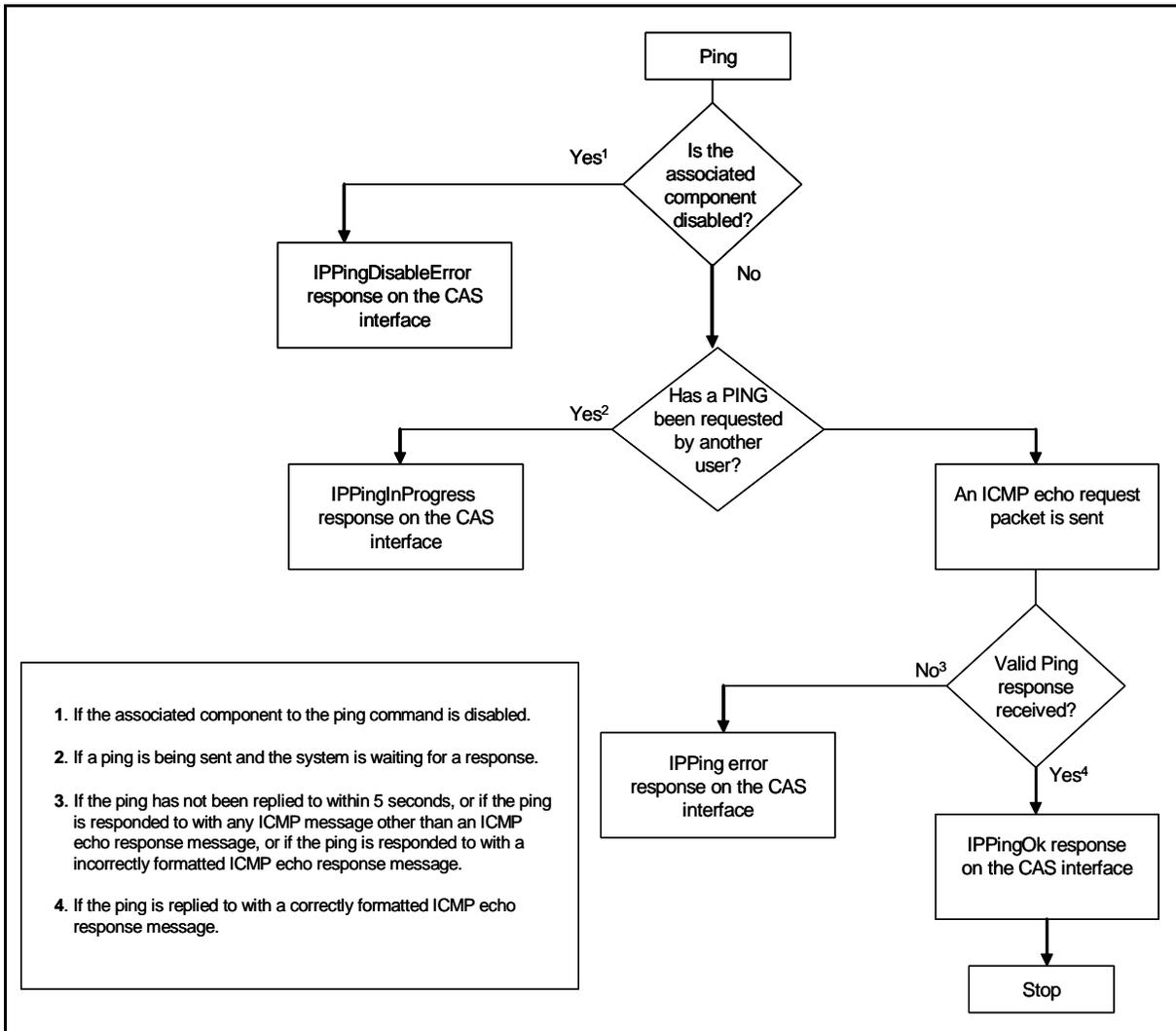


Table [VR ping verb and MG ping verb options \(page 159\)](#) shows the parallel between VR *ping* verb and the MG *ping* verb options and describes the options.

**VR ping verb and MG ping verb options**

VR	MG	Notes
ipAddr	ipAddr	This option is used to define the source IP address of the IP ICMP echo request packet. When not specified or specified as 0.0.0.0, the outgoing IP Interface or LogicalIf address is used as the source address.
srcAddr	srcAddr	
netmask	no present	
recordRoute	not present	
recordRoute	not present	
noOp	noOp	This option causes a <i>No Operation</i> option to be inserted into the IP header of the packet that carries the echo request. By default, the <i>noOp</i> option is not used.
looseSrcRoute	not present	
strictSrcRoute	not present	
timeStamp	no present	
size	size	This option is used to define the size of the IP packet to be echoed including the IP and ICMP header. The default is 64 bytes. The maximum size is 4096.
retry	retry	This option is used to define the number of times an echo request is resent if no echo reply is received. Default is 0.
traceRoute	traceRoute	This option is used to find the route the node would use to reach a particular destination IP address at the moment when the <i>ping</i> command is executed with this option. The size, retry and <i>continuous</i> option are ignored if used together with this option. By default, the <i>traceroute</i> option is not used.
continuous	continuous	This option causes ICMP to issue echo requests once per second to the host or hosts specified by the ipAddr and the netmask option. For every echo response ICMP receives, one line of output is printed. No output is produced if there is no response. The <i>stop</i> option is used to stop ICMP from sending the echo requests. By default, the <i>continuous</i> option is not used.

### VR ping verb and MG ping verb options

VR	MG	Notes
dontFragment	dontFragment	This option causes ICMP to set the Don't Fragment flag of the IP packet that carries the echo request. This is useful in determining path MTU. By default, the <i>dontFragment</i> option is not used.
dscp	dscp	This option causes the six most significant bits of <i>Type Of Service (TOS)</i> byte of the echo request packet to be set to the given value. These six bits are known as the <i>Differentiated Services Code Point (DSCP)</i> . Default is 0. This option cannot be used together with the <i>tos</i> option.
tos	tos	This option causes the <i>Type Of Service (TOS)</i> byte of the echo request packet to be set to the given value. Default is 0. This option cannot be used together with the <i>dscp</i> option.
stop	stop	This option is used to stop <i>ICMP</i> from sending echo requests due to a previously issued <i>ping</i> command with the continuous option. Under any other situation, the <i>ping</i> command with the stop option has no effect.

### Diagnosing ping failure from the *ControlConnection* component

Table [Troubleshooting Ping failure responses \(page 161\)](#) provides some additional information on how to diagnose ping failures.

**Troubleshooting Ping failure responses**

<b>Response</b>	<b>Problem</b>	<b>Solution</b>
IPPingDisableError from the <i>ControlConnection</i> component	The <i>ControlConnection</i> component is disabled	Check the status attribute of the <i>ControlConnection</i> component. If status attribute is: <ul style="list-style-type: none"><li>• <i>ConnectionNotReady</i> - a problem has been reported with the ATM or IP link resulting in the Control being in the disabled state.</li><li>• <i>VspNotReady</i> - the VSP is either disabled or locked resulting in the Control being in the disabled state.</li></ul>
IPPingDisableError from the <i>IpMConn</i> or <i>DebugIpAccess</i> component	The associated component ( <i>IpMConn</i> or <i>DebugIpAccess</i> ) is disabled.	Check the status attribute of the <i>IpMConn</i> or <i>DebugIpAccess</i> component. If status attribute is: <ul style="list-style-type: none"><li>• <i>AtmConnectionNotReady</i> - A problem has been reported with the ATM link resulting in the associated component (<i>IpMConn</i> or <i>DebugIpAccess</i>) being in a disabled state.</li><li>• <i>VspNotReady</i> - The VSP is either disabled or locked resulting in the associated component (<i>IpMConn</i> or <i>DebugIpAccess</i>) being in a disabled state.</li><li>• <i>ipNetworkInaccessible</i> - The GigE interface on the VSP3 card is disabled.</li></ul>

**Troubleshooting Ping failure responses**

<b>Response</b>	<b>Problem</b>	<b>Solution</b>
IpPingError	The ping to the specified IP address did not succeed.	Check the <i>txMessage</i> and <i>rxMessage</i> attribute of the <i>ControlConnection</i> component. The <i>txMessage</i> attribute must increment. If the <i>rxMessage</i> attribute increments, packets are being received. The received packets are not ICMP response messages however the connection into the MG exists.
<i>rxMessage</i> attribute does not increment	There may not be a connection to the card.	Check the provisioned connection from the card.  If a <i>Nap</i> , <i>Pap</i> , <i>SpvcAP</i> or <i>Aap</i> component is provisioned, check the associated VCC counts.  If the card is a VSP3 and has a GigE interface provisioned, (a <i>Lp/n Vsp GigE/n</i> component), check the operational attribute of the GigE component. For example, do the <i>frameTransmittedOk</i> and <i>framesReceivedOk</i> attributes increment? The <i>discardedFrames</i> attribute should not increment.

and

**Periodic routine exercise for MG15000**

The MG15000 Periodic Routine Exercise (REX) is a subsystem that provides periodic, automated, routine equipment-testing of protected equipment on MG15000 nodes. REX is supported on Carrier VoIP Media Gateway 15000 platforms that use Voice Service Processor 3-o (VSP3-o) FPs. REX automatically tests supported, protected card-pairs on the MG15000 shelf to guarantee that both units of a pair are healthy and to ensure that the spare unit is ready and able to provide full service in the case where a service-providing unit experiences a failure. The automated tests can be scheduled to run automatically or started manually.

Refer to NN10600-783 MG 15000 periodic routine exercise for more information.

**Attention:** The FP does not support the REX application in this release.

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REX is available for equipment pairs with the following protection schemes on an MG15000 node deployed in a Carrier VoIP solution:

- 1:1 Control Processors (CPs) which operate in hot standby mode
- 1+1 Fabrics which operate in a load sharing mode
- 1:1 Function Processors (FP) which operate in hot standby mode

The Carrier VoIP solutions that support the MG15000 REX application are as follows:

- Packet Trunking-IP (PT-IP) - allows an InterExchange (IXC) tandem, or Local Exchange Carrier (LEC) local tandem to migrate an existing TDM based tandem/toll switch to packet technology
- Universal Access-IP (UA-IP) - allows a Local Exchange Carrier (LEC) to migrate an existing end-office/local TDM switch to packet technology

Specifically, REX-tests can be run on the following spared cards:

- CP3 fabric, (DS1 BITS CP (NTHW06) or E1 BITS CP (NTHW08)) fabric cards
- 4-port gigabit Ethernet FP card (NTHW49)
- VSP3-o FP card, 2pOC3ChSmlrVsp3 (NTHW77)

**Attention:** The REX feature is supported on CP cards only, however, it invokes hardware tests on the other card types mentioned above.

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REX tests produce alarms and logs which can be used to proactively troubleshoot the MG15000 shelf and supported spared cards for their ability to carry traffic in the case where a switchover to protection is required. Your careful analysis of the alarms and logs generated from REX testing gives you insight as to the general health of the MG15000 and its card pairs for the configurations on which REX is supported.

Message alarms indicate the start and finish of REX and inform you of any events or problems encountered throughout the REX execution. Each message alarm provides an appropriate reason for its launch whenever REX returns failures.

Whenever REX fails it raises alarms. The alarm 7081 0003 with a major severity is a REX alarm that indicates REX has failed. Other alarm conditions raised in the system can cause REX to fail before it can run to completion,

thereby raising the REX 7081 0003 alarm with the system alarms. All the alarms raised are available from the active alarm list. Refer to NN10600-783 Periodic Routine Exercise for more information.

It is normal for alarms raised on REX testing to clear at the end of the REX interval. These alarms can be attributed to REX execution. Outstanding alarms indicate problems. For new alarms and alarms that persist after REX has run, see: NN10600-500 Multiservice Switch 6400/7400/15000 Alarms.

In this section, see [Troubleshooting REX \(page 181\)](#) to troubleshoot REX alarms. If problems persist, refer to NN10600-520 Nortel Multiservice Switch 7400/15000 Fault and Performance Management: Troubleshooting for test and repair of faulty components. Alarms associated with MG15000 REX are visible to the OSS in an SCC2 log stream.

## State change notifications

When the OSI operational or procedural status of a component changes, the system automatically generates a state change notification (SCN).

Components use SCNs to notify the components above and below them on the component hierarchy that they are no longer in service. Like alarms, state change notifications contain OSI state information and can help you determine the impact of a failure.

The following examples describe conditions that cause Nortel Multiservice Switch systems to generate a state change notification:

- The voice services FP has failed. The *Nsta* component generates a proxy state change notification.
- When a virtual channel connection (VCC) is enabled and the system starts to collect traffic statistics, the system generates a state change up notification.
- When a VCC is disabled and the system stops collecting traffic statistics, the system generates a state change down notification.
- When REX-testing starts or stops.
- When operational changes such as the following occur for the M2UA component:
  - An internal resource failure condition has been detected or has cleared.
  - An AS link has gone up or down.
  - Overload conditions (setting and clearing) are detected on the adjunct processor.
- When operational changes such as the following occur for the AS component:
  - The SG connects to an MGC for the first time, but no application traffic is transported.
  - An internal resource fault was detected and/or all MGC associations have been lost.
  - The application server becomes active and the SG can now carry application traffic.
- When operational changes such as the following occur for the M2UA ASP component:
  - The SG has established the initial communication with the application server process.
  - An internal resource fault was detected and/or the association with the application server process has been lost.

- The SG is connected to the application server process and application traffic is being transported.
- When operational changes such as the following occur for the MTP2 component:
  - An internal resource failure or a layer 1 fault has been detected or has cleared.

## Fault handling for MG

Nortel Multiservice Switch MG faults can be categorized as TDM interface, ATM interface, and buffer underflow faults. And, depending on your configuration, you can change how MG communicates ATM failures to the narrowband node to which it connects. See the following sections for more information:

- [TDM interface faults \(page 166\)](#)
- [ATM interface faults \(page 168\)](#)
- [Buffer underflow faults \(page 170\)](#)
- [Configuring the response to failures \(page 170\)](#)

## TDM interface faults

Nortel Multiservice Switch systems generate the following types of alarms for the TDM interface:

- loss of signal (LOS)
- loss of frame (LOF)
- alarm indication signal (AIS)
- degraded signal (DS)
- remote alarm indication (RAI)
- idle signal (IS) for DS3 ports
- far end alarm indication (FAI) for DS3 ports with C-bit parity enabled
- C-bit mismatch alarm, C-bit parity mode mismatch between near end and far end.

The TDM interface has the following fault categories:

- [Non-switched MG faults \(page 167\)](#)
- [Switched MG faults \(page 167\)](#)

### **Non-switched MG faults**

Nortel Multiservice Switch systems report all alarm conditions to the fault management system. No further action occurs for DS and FAI alarms. With all other alarms, the system informs the remote interworking function using fault indication packets (FIP).

When RAI, LOS, LOF, or AIS alarms occur, Multiservice Switch systems create an FIP that shows all local conditions. The system sends this FIP continually every few seconds on all affected AAL2 channels, even if no change occurs in the fault status. When fault conditions change, the system sends an updated FIP.

When a FIP with one or more fields showing an alarm condition arrives on an AAL2 channel, Multiservice Switch systems react differently depending on the type of fault. For RAI faults, the system transmits RAI fault indications to the TDM network. For all other faults, the system transmits either AIS fault indications or trunk conditioning data on the corresponding service interface time slot, depending on how the *Brag* component is provisioned. Trunk conditioning stops only after the AAL2 channel receives an FIP in which all fault indication fields are set to zero.

### **Switched MG faults**

Detection of TDM fault conditions and port management type reactions to TDM failures are identical to those of non-switched MG. MG reports all alarm conditions to the fault management system; however, the alarm actions are different.

When an individual facility becomes unavailable because of a network fault, MG does not propagate the fault indication to the far end TDM interface. Instead, MG deletes any narrowband calls using that trunk and notifies the media gateway controller of the state change of the TDM interface.

For switched MG using ATM connections, an unsolicited change notification is sent.

For switched MG using IP connections, an unsolicited ServiceChange message is sent when H.248 control protocol is used.

During the time that the facility is unavailable, MG responds to control commands (such as Create Connection) for any endpoint on the affected trunk with a negative acknowledgement. When the fault clears, MG sends another notification or RSIP to the controller and begins to accept control commands again.

On detection of a TDM fault such as a loss of service (LOS), loss of frame (LOF), loss of multiframe (LOMF), the channel associated signaling (CAS) bits are frozen to prevent flooding of the CAS change detection software.

## ATM interface faults

Nortel Multiservice Switch systems generate the following types of alarms for the ATM interface:

- loss of signal (LOS)
- loss of frame (LOF)
- alarm indication signal (AIS), including OAM F5 AID
- degraded signal (DS)
- remote alarm indication (RAI)
- loss of cell delineation
- OAM F5 remote defect indication (RDI)
- OAM F5 loop back failure

Multiservice Switch systems follow OAM fault management procedures defined in ITU-T I.610. The system supports both end-to-end and segment F5 fault management flows.

If MG is using ATM PVCs, its behavior towards ATM interface faults is described in

- [Behavior of non-switched MG \(page 168\)](#)
- [Behavior of switched MG \(page 168\)](#)

If MG is using ATM PSVCs or SPVC, its behavior towards ATM interface faults is described in

- [Bearer VCC failure \(page 169\)](#)
- [Control VCC failure \(page 170\)](#)

### Behavior of non-switched MG

Nortel Multiservice Switch systems interpret all ATM alarms as ATM VCC loss of connectivity. Therefore, Multiservice Switch nodes condition all service interface time slots related to the troubled VCC. Trunk conditioning stops after ATM VCC connectivity is restored and the channel receives an FIP in which all fault indication fields are set to zero.

### Behavior of switched MG

MG continues to interpret all ATM alarms (except CPS) as ATM VCC loss of connectivity; however, in switched mode, MG reacts differently. When any media ATM trunk receives loss of continuity (LOC) alarms, MG does not propagate the fault condition to the near end TDM interface. Instead, MG immediately deletes the affected narrowband connections and notifies the media gateway controller. While the VCC is in LOC fault, the VCC is not

available within the trunk selection algorithm. When the LOC alarm is removed, the media gateway controller is once again able to assign traffic to the ATM VCC trunk.

The ATM system has inherent backoff mechanisms for large-scale failures. The recovery time for large numbers of failed trunks can be 5 or more minutes depending on how busy the ATM cards are when trying to recover lost connections.

If an active connection fails to receive any voice or comfort noise for a period greater than the *PacketLossIntegration* period. MG deletes the affected narrowband connection and sends a delete connection request to the controller. Until the first voice or comfort noise packet is received, this timer uses a timeout period which is double the *PacketLossIntegration* period. During the timeout, the de-jitter buffer can underflow and the TDM stream plays out idle or comfort noise.

### **Bearer VCC failure**

If network failures cause a bearer VCC to lose connectivity, the MG ATM trunks can re-route themselves by using PSVCs or SPVCs.

For switched MG using ATM, if a VCC transporting bearer traffic is torn down because of a failure in the ATM network, a hold-off timer for the associated *atmTconn* component is started. At the same time, the *Aap* or *SpvcAp* component attempts to re-establish a new VCC as described in [Retry mechanism \(page 128\)](#). The retry mechanism continues to operate until the VCC is re-established. If the VCC is successfully re-established before the hold-off timer expires, the media gateway controller is not notified of the failure and narrowband calls on the VCC are maintained. Note that bearer data is lost on associated narrowband calls while the *Aap* or *SpvcAp* component attempts to re-establish the VCC.

If the *Aap* or *SpvcAp* component cannot set up a new PSVC or SPVC before the hold-off timer expires, any associated narrowband calls are deleted and notification is sent to the media gateway controller. If the VCC is re-established after the hold-off timer expires, the media gateway controller is not informed, but the VCC becomes available for use again by the MG's trunk selection algorithm.

While the hold-off timer is running, no new narrowband connections can be allocated to the ATM trunk until it is re-established.

The hold-off mechanism also applies to switched MG using IP.

### Control VCC failure

When a VCC transporting control information loses ATM connectivity, the MG application (that is, the *Aap* or *SpvcAp* component) attempts to re-establish the trunk on an alternative route. If more than one remote ATM address is specified, the application also attempts to connect to a different ATM address. Multiple ATM addresses are used when more than one router is available in the network (through router sparing) between the media gateway controller and the MG.

Existing narrowband calls are maintained on the MG except if the control VCC is broken for a period longer than the media gateway controller allows.

### Buffer underflow faults

If the de-jitter buffer underflows, Nortel Multiservice Switch systems monitor the time it takes to refill the buffer. If the time exceeds the value configured for the *lossIntegrationPeriod* attribute, the system sets a buffer underflow fault. The system then applies trunk conditioning to the affected time slot and sends out a fault indication packet (FIP). The system sends this FIP continually every few seconds on all affected AAL2 channels, even if no change occurs in the fault status. Trunk conditioning stops only after the buffer underflows or the call clears and the channel receives an FIP in which all fault indication fields are set to zero.

The system begins transmitting after the buffer fills to the configured packet delay variation tolerance level. Fault status remains in effect until the system transmits for the period set by the *lossClearPeriod* attribute.

### Configuring the response to failures

The *tdmResponseForFailures* attribute of the *Brag* component is used to determine what the TDM egress response is when the ATM interface becomes disabled and when a FIP is received. A FIP is created as a result of a far end LOS, LOF, LOMF, AIS, Chan locked, and TDM Ip down. By default, MG sets this attribute to an AIS, which instructs the system to transmit AIS toward the TDM interface in all cases. The *tdmResponseForFailures* attribute can also be provisioned to transmit trunk conditioning (TC) regardless of the interface or type of signaling.

The *noServiceResponse* attribute of the DS1 or E1 Channel (Chan) TrunkConditioning (TC) component determines whether TC or alarm AIS is transmitted when the channel does not have a service provisioned or the service is unavailable. The *noServiceResponse* attribute can be provisioned to either TC or AIS.

## Troubleshooting general MG problems

Nortel Multiservice Switch systems notify you of problems with MG by generating one or more alarms. Use the alarm text and the OSI state information to find possible causes of the problem. Other troubleshooting activities involve running tests on hardware. For procedures and tests supported by specific FPs, see *Nortel Multiservice Switch 7400/15000/20000 Troubleshooting* (NN10600-520) or *Nortel Multiservice Switch 7400/15000/20000 Fundamentals – FP Reference* (NN10600-551).

To troubleshoot at the service level, display the values for individual operational and statistical attributes using the procedures in either *Nortel Media Gateway 7480/15000 Non-switched Service Configuration Management* (NN10600-781) or *Nortel Media Gateway 7480/15000 Switched Service Configuration Management* (NN10600-782).

See [Troubleshooting general MG problems \(page 171\)](#) to help diagnose and correct problems. For additional troubleshooting information, see *Nortel Multiservice Switch 7400/15000/20000 Troubleshooting* (NN10600-520) and *Nortel Multiservice Switch 7400/15000/20000 ATM Fundamentals* (NN10600-700).

### Troubleshooting general MG problems

Symptom	Probable causes	Corrective measures
There is a loss of signal (LOS) or loss of frame (LOF) alarm on the <i>DS3</i> component of the DS3C TDM FP.	A cable is broken or disconnected.	Verify the cabling for the DS3C TDM FP.
	There is an incorrect <i>lineLength</i> attribute configuration.	Verify that the <i>lineLength</i> attribute is set according to the length of the cable, to a value between 0 and 450.
There is an alarm indication signal (AIS) alarm on the <i>DS3</i> component of the DS3C TDM FP.	There is a fault in the equipment or cabling upstream from the Multiservice Switch node.	Verify the cabling.
There is a remote alarm indication (RAI) signal alarm on the <i>DS3</i> component of the DS3C TDM FP.	There is a fault in the equipment or cabling downstream from the Multiservice Switch node.	Verify the cabling and check the far end device for problems.
There is a C-Bit parity alarm on the <i>DS3</i> component of the DS3C TDM FP (non-switched mode only).	The setting for the <i>cBitParity</i> attribute does not match at both ends.	Verify that the settings for C-Bit parity for the DS3C TDM FP match the device to which it connects.
(1 of 6)		

**Troubleshooting general MG problems (continued)**

<b>Symptom</b>	<b>Probable causes</b>	<b>Corrective measures</b>
There is a LOS or LOF alarm on multiple E1 components of the 32-port E1 TDM FP.	A cable is broken or disconnected.	Verify the cabling for the 32-port E1 TDM FP and the multiport aggregate device.
	A multiport aggregate device has failed.	Replace the multiport aggregate device.
There is an LOF alarm on a <i>DS1</i> component of the DS3C TDM FP or on an E1 component of the 32-port E1 TDM FP.	The setting for the DS3 <i>clockingSource</i> attribute is not compatible with the device to which it connects.	Verify that the clocking source for the <i>DS3</i> component is compatible with the device to which it connects.
	There is a fault in the equipment or in the DS1 or E1 line cabling.	Verify the DS1 or E1 level cabling. If, for example, the FP connects to a multiplexer, check the DS1 cabling for that link. For the 32-port E1 TDM FP, verify the cabling for the multiport aggregate device.
	The setting for the DS1 <i>lineType</i> attribute does not match the setting for the equipment to which it connects, or is not compatible with the service.	Verify that the DS1 <i>lineType</i> attribute matches the equipment to which it connects and is compatible with the service.
There is an LOF alarm on a <i>DS1</i> component of the DS3C TDM FP (non-switched mode only).	The setting for the <i>zeroCoding</i> attribute does not match the setting for the equipment to which it connects.	Verify that the <i>zeroCoding</i> setting matches the device to which it connects.
There is an AIS alarm on the <i>DS1</i> component of the DS3C TDM FP or on an E1 component of the 32-port E1 TDM FP.	There is a fault in the equipment upstream from the Multiservice Switch node.	Check the far end device for problems.
There is a remote alarm indication (RAI) signal alarm on the <i>DS1</i> component of the DS3C TDM FP or on an E1 component of the 32-port E1 TDM FP.	There is a fault in the equipment downstream from the Multiservice Switch node.	Check the far end device for problems.
(2 of 6)		

**Troubleshooting general MG problems (continued)**

Symptom	Probable causes	Corrective measures
The MG service is not operational and no calls are possible. The <i>Nsta</i> component is disabled.	The voice services FP is locked.	Unlock the voice services FP.
	The voice services FP has failed and there is no spare FP.	Lock and unlock the voice services FP.  Restart the voice services FP.  Replace the voice services FP.
	The provisioning for the <i>PModule</i> attributes for the voice services FP does not match the physical placement of modules on the FP.	Check that the provisioning for the attributes of the <i>PModule</i> component matches the physical placement of modules on the FP.
	All of the <i>Connection</i> components are locked or disabled.	Check the status of all the <i>Connection</i> components.
Calls are not possible for a connection.	The <i>Connection</i> component is locked.	Check the status of the <i>Connection</i> component.
	If the <i>failureCause</i> attribute for the <i>Brag</i> component is set to <i>vspNotReady</i> , either the voice services FP is initializing, or the voice services FP has failed.	Wait for the voice services FP to initialize. Or, if there is a problem with the FP, reset it. If the card does not initialize properly, replace the voice services FP.
(3 of 6)		

**Troubleshooting general MG problems (continued)**

Symptom	Probable causes	Corrective measures
Calls are not possible for a connection.	(non-switched mode only) If the <i>layer2Status</i> attribute for the <i>Ccst</i> component is down, the layer 2 connection from end to end has failed. Or, the signaling VCC does not have enough bandwidth to carry the signaling traffic.	Check the far end devices, for example, the narrowband node on one end and the PABX on the other.  Verify that the signaling VCC has sufficient bandwidth.
	If the <i>failureCause</i> attribute for the <i>Brag</i> component is set to <i>operatorLock</i> , either a parent component or a related component, such as the <i>Vsp</i> or <i>Channel</i> component, is locked.	Verify whether or not any parent or related components are locked.
	There is a problem with the ATM interface.	Investigate possible problems with the ATM interface. For troubleshooting information, see <i>Nortel Multiservice Switch 7400/15000/20000 ATM Fundamentals</i> (NN10600-700).
	The system is receiving errored AAL2 packets or non-AAL2 packets.	Check the far-end ATM device to ensure that the VPI.VCI values match those configured for the connection. Verify that the far end device is sending AAL2 packets.
There is no speech on voice calls.	The setting for cell scrambling on the ATM interface does not match the device to which it connects. If this problem occurs, Multiservice Switch systems generate a common part sublayer alarm.	Verify that the setting for cell scrambling matches the device to which it connects.
(4 of 6)		

**Troubleshooting general MG problems (continued)**

<b>Symptom</b>	<b>Probable causes</b>	<b>Corrective measures</b>
There is no speech or data on a call.	If the <i>packetLossStatus</i> attribute of the <i>Nsta Conn Brag Brac</i> component is set to <i>loss</i> and trunk conditioning has started on the TDM interface, no ATM packets are being received from the far end.	Check the ATM device at the far end for problems.
Speech on voice calls is distorted.	If the <i>currentRate</i> attribute for the <i>Brag</i> component displays a rate lower than the rate configured as the maximum voice rate, the ATM link is congested.	Wait for congestion to be relieved on the link, which increases the bandwidth for voice calls. If congestion occurs frequently, the system has not been engineered to effectively handle the traffic. Therefore, the traffic management settings need to be re-engineered.
	The setting for the <i>bufferSize</i> attribute for that <i>Brag</i> component is not compatible with the setting for the <i>packetDelayVariation-Tolerance</i> attribute.	Verify that the settings for the <i>bufferSize</i> attribute and the <i>packetDelayVariation-Tolerance</i> attribute are compatible. Generally, ensure that the buffer size is twice the setting for the <i>packetDelay-VariationTolerance</i> attribute.
Modem/Fax calls not working.	Clock-timing source of MG is different from other nodes in the connected network.	Check the clock-timing sources of the MG and other network nodes in the connected network. For information, see <i>Nortel Multiservice Switch 15000/20000 Planning – Site Requirements</i> (NN10600-125).
	Insufficient bandwidth for call at interfaces.	Verify bandwidth settings at interfaces.
(5 of 6)		

### Troubleshooting general MG problems (continued)

Symptom	Probable causes	Corrective measures
	An initial address message (IAM) from a media gateway controller (MGC) such as Nortel Networks Succession Networks CS2000 or CS3000, does not have 64-bit/s clear data set.	Verify the IAM message.
REX has stopped after detecting a failure during testing.	REX alarms	See <a href="#">Troubleshooting REX (page 182)</a>
(6 of 6)		

### Troubleshooting local announcements

The table [Troubleshooting local announcements \(page 176\)](#) provides additional guidelines to help you solve problems that may be associated with the transfer and playout of local announcements.

### Troubleshooting local announcements

Symptom	Probable causes	Corrective measures
Multiservice Switch Media Gateway issues a warning when you provision the <i>fileName</i> attribute of the <i>LocalAnnouncements</i> component.	The required index and audio files are not in the correct location on the CP	Verify that the announcement files share the same name (excluding extension).  Verify that the announcement files are in the correct the following directory: <i>/user/MG/announcements.</i>
(1 of 3)		

**Troubleshooting local announcements (continued)**

<b>Symptom</b>	<b>Probable causes</b>	<b>Corrective measures</b>
You fail your attempt to provision the <i>fileName</i> attribute of the <i>LocalAnnouncements</i> component.	The file format is incorrect.	Verify that the files are stored in UAS format 2.1b or 3.0a.  Verify that the files use an encoding rate of 64 kbit/s (G.711A and G.711U) or 32 kbit/s (G.726).  If necessary, regenerate the files with the APS and re-transfer them to the MG CP.
	The files were incorrectly transferred.	The files must be transferred as binary files. Re-transfer them to the MG CP.
	The files on the CP are corrupted.	Re-transfer the files to the MG CP.
(2 of 3)		

**Troubleshooting local announcements (continued)**

<b>Symptom</b>	<b>Probable causes</b>	<b>Corrective measures</b>
<p>The MGC is recording a large number of failed announcement requests, or many announcement requests generate NACK responses from the MG.</p>	<p>If no alarms are set against the <i>LocalAnnouncements</i> component and the value of the <i>unknownNameRequests</i> attribute is large and incrementing, the MGC is requesting an announcement name and language combination that the MG does not have.</p>	<p>Verify that the catalog file has an entry for each combination of announcement alias used and the language setting on all basic rate groups.</p>
	<p>If no alarms are set against the <i>LocalAnnouncements</i> component and the value of the <i>blockedRequests</i> attribute is large and incrementing, the MGC is overloading the MG with announcement requests.</p>	<p>Verify the value of the <i>announcementResourceInUse</i> attribute that shows how close to exhaustion the announcement resource currently is.</p> <p>Verify the value of the <i>peakAnnouncementResourceUsed</i> attribute that shows how close to exhaustion the announcement resource has been in the past.</p> <p>Remedial actions may include:</p> <ul style="list-style-type: none"> <li>• using G.726 (compressed) announcements rather than G.711A and G.711U (uncompressed) announcements</li> <li>• shortening the length of announcements that are used often</li> <li>• using the universal audio server (UAS) or tones instead of local announcements</li> </ul>
<p>(3 of 3)</p>		

## Troubleshooting G.729 Annex A and B voice compression, silence suppression, and DTMF upspeed

The table [Troubleshooting G.729 Annex A and B voice compression, silence suppression, and DTMF upspeed \(page 179\)](#) provides additional guidelines to help you solve problems that may be associated with G.729 Annex A and B functionality.

### Troubleshooting G.729 Annex A and B voice compression, silence suppression, and DTMF upspeed

Symptom	Probable causes	Corrective measures
Speech on voice calls is distorted.	The G.729 Annex A and B MG trunk is misconnected to a G.726 trunk.	Verify that the G.729 Annex A and B and G.726 trunks are connected correctly.
Size and Sequence Errors	The G.729 Annex A and B MG trunk is misconnected to a G.726 trunk.	Verify that the settings for <i>sizeErr</i> and <i>seqErr</i> attributes are compatible with G.729 Annex A and B. Verify that the G.729 Annex A and B and G.726 trunks are connected correctly
DTMF tone distortion	The <i>dtmfTransport</i> attribute is set to disabled	Set <i>dtmfTransport</i> attribute to upspeed to enable DTMF tones to be sent at G.711A and G.711U as tone distortion can occur when tones are sent through the G.729 Annex A and B codec.

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**Attention:** Upspeeding is not currently supported for multi-frequency (MF) tones.

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## Troubleshooting PRI backhaul

The table [Troubleshooting PRI backhaul \(page 180\)](#) provides additional guidelines to help you solve problems that may be associated with PRI backhaul.

### Troubleshooting PRI backhaul

Symptom	Probable causes	Corrective measures
There is a layer 2 failure of the D-channel alarm	A cable is broken or disconnected.	Verify the cabling.
	Transmission problems.	Verify if there are transmission problems such as error bursts and slips.
	D-channel disabled at PRI-controlled device.	Verify if the D-channel has been disabled by an operator at the PRI-controlled device.
	The PRI side (network or user) is not configured correctly.	Verify the configuration of the user and network at both ends of the PRI trunk. The same value of <i>user</i> or <i>network</i> should not be set on both ends.

### Troubleshooting SS7 backhaul

The table [Troubleshooting SS7 backhaul \(page 181\)](#) provides additional guidelines to help you solve problems that may be associated with SS7 backhaul.

**Troubleshooting SS7 backhaul**

Symptom	Probable causes	Corrective measures
There is a layer 2 failure of the MTP level 2 link	Operator disables link from either the CS2000/MGC or TDM far end devices. TDM error (layer 1 or layer 2) between the MG and the far end device.	<p>Check cabling.</p> <p>Check for transmission problems. For example, error bursts, slips, and so on.</p> <p>Check for disabling of the SS7 link by an operator at the TDM far end device</p> <p>Check for disabling of the SS7 link by an operator at the CS2000/MGC</p>
The M2UA and/or AS components are disabled.	<p>Packet network failure/outage</p> <p>Mis-provisioned Nsta/n Vgs M2ua As/n Asp/n ip_address</p>	<p>Verify <i>Nsta/n Vgs Ctrl/sg</i> component is enabled</p> <p>Verify ipaddress provisioning data</p> <p>Monitor the <i>Nsta/n Vgs Ctrl/sg</i> component to ensure it is receiving messages</p> <p>Monitor the <i>Nsta/n Vgs Ctrl/sg Sctppport/n Sctplink</i> component to determine the status of the links</p>

**Troubleshooting REX**

The table [Troubleshooting REX \(page 182\)](#) provides additional information to help you solve problems that may be associated with REX. REX tests run on the spared card of the pair and during that time the spare card is not available to provide protection. Some shelf, CP, and FP alarms are raised and cleared during the REX tests. The alarms that persist require attention. Refer to NN10600-783, MG 15000 Periodic Routine Exercise for alarms raised during REX execution. Refer to *Nortel Multiservice Switch 7400/15000/20000 Troubleshooting* (NN10600-520) for test and repair of faulty component.

**Troubleshooting REX**

<b>Phase</b>	<b>Error condition</b>	<b>Impact</b>	<b>Corrective measures</b>
Precheck	One or more precheck commands fail.	REX stops, alarm generated.	Verify the alarms generated and check the configuration.
	Any card crash during precheck.	REX stops and alarm generated.	Verify the alarms generated and check the tracelog files. Call Nortel GNTS for assistance.
Hardware test	Active CP crashes.	Service outage for entire shelf if standby CP is under test. If REX is testing other spare units, REX stops, alarm generated.	Call Nortel GNTS for assistance.
	Service FP (VSP3-o) crashes.	Partial service outage if the spare card is under testing. If not, automatic switchover. REX stops, alarm generated.	Verify the alarms generated and check the tracelog files. Call Nortel GNTS for assistance.
	Service unit running in load sharing mode (fabric, 4pGigE) crashes.	Total service outage if the mate card is under testing (assuming that there is only one 4pGigE card pair configured on the switch). Otherwise the mate card picks up all the traffic. REX stops, alarm generated.	Verify the alarms generated and check the tracelog files. Call Nortel GNTS for assistance.
	Spared unit crashes.	If REX detected that the card pair scheduled to run tests, no longer runs in sparing mode, REX stops and alarm generated.	Call Nortel GNTS for assistance.
Postcheck	One or more postcheck commands fail.	REX stops, alarm generated.	Verify the alarms generated and check the tracelog files.
	Active CP crashes.	REX does not resume after switchover.	Call Nortel GNTS for assistance.
	Any other card crashes during postcheck.	REX fails. Alarm is generated to report the failure.	Call Nortel GNTS for assistance.

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# Definitions of audible tones by country

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This section defines the audible tones that Nortel Multiservice Switch Media Gateway can generate for the following countries:

- [Argentina \(page 185\)](#)
- [Australia \(page 187\)](#)
- [Austria \(page 189\)](#)
- [Belgium \(page 192\)](#)
- [Brazil \(page 194\)](#)
- [Mexico Custom 1 \(page 234\)](#)
- [Canada \(page 198\)](#)
- [Chile \(page 201\)](#)
- [China \(page 203\)](#)
- [Czech Republic \(page 205\)](#)
- [France \(page 208\)](#)
- [Germany \(page 210\)](#)
- [Greece \(page 212\)](#)
- [Hong Kong \(page 214\)](#)
- [India \(page 217\)](#)
- [Ireland \(page 219\)](#)
- [Israel \(page 221\)](#)
- [Italy \(page 223\)](#)
- [Japan \(page 225\)](#)
- [Japanese fire and police trucks \(JFPT\) \(page 227\)](#)
- [Korea \(page 228\)](#)
- [Malaysia \(page 230\)](#)
- [Mexico \(page 232\)](#)

- [Mexico Custom 1 \(page 234\)](#)
- [Netherlands \(page 236\)](#)
- [New Zealand \(page 238\)](#)
- [Pakistan \(page 242\)](#)
- [Panama \(page 240\)](#)
- [Philippines \(page 244\)](#)
- [Poland \(page 246\)](#)
- [Portugal \(page 248\)](#)
- [Romania \(page 250\)](#)
- [Russia \(page 252\)](#)
- [Singapore \(page 255\)](#)
- [Spain \(page 257\)](#)
- [Sweden \(page 259\)](#)
- [Switzerland \(page 261\)](#)
- [Taiwan \(page 263\)](#)
- [Thailand \(page 265\)](#)
- [Turkey \(page 267\)](#)
- [United Kingdom \(page 269\)](#)
- [United States \(page 271\)](#)
- [Venezuela \(page 274\)](#)

## Argentina

### Definition of supported tones for Argentina

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425 (+/- 25)	continuous	20	-10 (+/- 1)
(audible) ringing	cg/rt	425 (+/- 25)	1 on, 4 off	infinite	-10 (+/- 1)
busy	cg/bt	425 (+/- 25)	0.3 on, 0.2 off	infinite	-10 (+/- 1)
congestion	cg/ct	425 (+/- 25)	0.3 on, 0.4 off	infinite	-10 (+/- 1)
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.333 (f1) on, 0.333 (f2) on, 0.333 (f3) on, 1.0 off	1 cycle	-10/ -10/ - 10
warning	cg/wt	1400 (+/- 50)	0.1 on	1 cycle	-10 (+/- 1)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425 (+/- 25)	0.3 on	1 cycle	-14 (+/- 1)
caller waiting	cg/cr	425 (+/- 25)	1.0 on, 4.0 off	infinite	-10 (+/- 1)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	1400 + 2060 + 2600 (+/-2%) (VSP2 / VSP3-o/ 2pVSP4e)  1400 + 2060 + 2450 + 2600 (+/-2%) (VSP3)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (+/-1.5 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 +/-1.5dB0 (VSP3)
negative acknowledge	xcg/nack	425 (+/- 25)	0.3 on, 0.4 off	60	-10 (+/- 1)

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Definitions of audible tones by country

**Definition of supported tones for Argentina (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
vacant number	xcg/vac	425 (+/- 25)	0.3 on, 0.4 off	infinite	-10 (+/- 1)
special conditions dial tone	xcg/spec	425 (+/- 25)	1.0 on, 0.25 off	20	-10 (+/- 1)
recall dial tone	srvtn/rdt	425 (+/- 25)	continuous	20	-10 (+/- 1)
confirmation	srvtn/conf	350 + 440 (+/- 0.5%)	0.1 on, 0.1 off (+/- 10%)	3 cycles	-13 + -13 (+/- 1.5 dB)-
held	srvtn/ht	425 (+/- 25)	0.4 on, 0.2 off, 0.4 on, 4.0 off	infinite	-10 (+/- 1)
message waiting	srvtn/mwt	425 (+/- 25)	1.0 on, 0.25 off	20	-10 (+/- 1)
(2 of 2)					

## Australia

### Definition of supported tones for Australia

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
dial	cg/dt	400 + 425 + 450	continuous	20	-18 + -18 + -18
(audible) ringing	cg/rt	400 + 425 + 450	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-18 + -18 + -18
busy	cg/bt	425	0.375 on, 0.375 off	infinite	-13
congestion	cg/ct	425 (f1)/ 425(f2)	0.375 (f1) on, 0.375 off, 0.375 (f2) on, 0.375 off	infinite	-13 (f1)/-23 (f2)
special information	cg/sit	950 + 1400 + 1800 (+/- 50)	0.33 on, 0.33 off, 0.33 on, 1.0 off	1 cycle	-13 + -13 + -13
warning	cg/wt	1400 (+/- 1.5%)	0.5 on, (+/- 10%)	1 cycle	-34
pay phone recognition	cg/prt	1100+1750 (f1) 750+1450 (f2)	0.075 (f1), 0.15 traffic, 0.075 (f2)	1 cycle	-23 + -23 -23 + -23
call waiting	cg/cw	425	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-13
caller waiting	cg/cr		cg/rt for 30, followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	3200	continuous	infinite	-8
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Australia (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
negative acknowledge	xcg/nack	mapped to xcg/vac		60	mapped to xcg/vac
vacant number	xcg/vac	425	2.5 on, 0.5 off	infinite	-13
special conditions dial tone	xcg/spec	425	continuous	20	-13
recall dial tone	srvtn/rdt	425	continuous	20	-13
confirmation	srvtn/conf	425	0.06 on, 0.06 off	1 cycle	-12
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	400 + 425 + 450	0.1 on, 0.04 off	10	-18 + -18 + -18
(2 of 2)					

## Austria

### Definition of supported tones for Austria

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 5%)	Cadence (s) (+/- 20%)	Duration (s) (+/-10%)	Level (dBm) (+/- 3.5 dB)
dial	cg/dt	420	continuous	20	-10 (+/- 10%)
(audible) ringing	cg/rt	420	1 on, 5 off	infinite	-10 (+/- 10%)
busy	cg/bt	420	0.4 on, 0.4 off	infinite	-10 (+/- 10%)
congestion	cg/ct	420	0.2 on, 0.2 off	infinite	-10 (+/- 10%)
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1 off (+/- 0.25)	1 cycle	-10 (+/- 10%)
warning	cg/wt	1400 (+/- 1.5%)	0.5 on, (+/- 10%)	1 cycle	-34 (+/-1 dB)
pay phone recognition	cg/prt	1633 (f1)/ 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-20/ -20 (+/- 2 dB)
call waiting	cg/cw	420	0.4 on	1 cycle	-3 (+/- 10%)
caller waiting	cg/cr		cg/rt for 30 (+/- 10%), followed by cg/bt for remainder	infinite	-10 (+/- 10%)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 3)					

Definitions of audible tones by country

**Definition of supported tones for Austria (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 5%)	Cadence (s) (+/- 20%)	Duration (s) (+/-10%)	Level (dBm) (+/- 3.5 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 15)  1404 + 2060 + 2452 + 2604 (VSP3) (+/- 15)	continuous	infinite	-5 + -5 + -5 (+/- 1dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/- 1dB) (VSP3)
negative acknowledge	xcg/nack	380 + 420	0.4 on, 0.4 off	60	-13 (+/- 10%)
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	380 + 420	continuous	20	-13 (+/- 10%)
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	380 + 420	1.0 on, 5.0 off	1 cycle	-13 (+/- 10%)
held	srvtn/ht	450 (+/- 15)	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-8 (+/-1 dB)
message waiting	srvtn/mwt	420	(0.1 on, 0.1 off) x 10 then continuous	20	-10 (+/- 10%)
intrusion pending	int/pend	silence (no frequency), signal complete immediate			
intrusion	int/int	420	0.15 on, 0.15 off, 0.15 on	1 cycle	-10 (+/- 10%)
intrusion reminder	int/rem	silence (no frequency), signal complete immediate			
toll break-in	int/tbi	silence (no frequency), signal complete immediate			
(2 of 3)					

**Definition of supported tones for Austria (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 5%)	Cadence (s) (+/- 20%)	Duration (s) (+/-10%)	Level (dBm) (+/- 3.5 dB)
intrusion queue	int/intque	silence (no frequency), signal complete immediate			
busy verification	int/bv	silence (no frequency), signal complete immediate			
(3 of 3)					

## Belgium

### Definition of supported tones for Belgium

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/-10%)	Level (dBm) (+/- 0.5 dB)
dial	cg/dt	425 (+/- 5)	continuous	20	-4.5
(audible) ringing	cg/rt	425 (+/- 5)	1.0 on, 3.0 off (+/-0.1)	infinite	-4.5
busy	cg/bt	425 (+/- 15)	0.5 on, 0.5 off (+/- 10%)	infinite	-4.5
congestion	cg/ct	425 (+/- 15)	0.167 on, 0.167 off (+/-0.012)	infinite	-4.5
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1 off (+/- 0.25)	1 cycle	-4.5/ -4.5/ -4.5
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.18 on (+/- 0.02)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-20/ -20 (+/- 2 dB)
call waiting	cg/cw	1400 (+/- 50)	0.175 on (+/ -0.075), 0.175 traffic (+/-0.075), 0.175 on (+/ -0.075)	1 cycle	-15 (+/- 2 dB)
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	

(1 of 2)

Definitions of audible tones by country

**Definition of supported tones for Belgium (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/-10%)	Level (dBm) (+/- 0.5 dB)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	440 (+/- 2%)	0.05 on, 0.05 off (+/- 10%)	infinite	-11 (+/- 2 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (+/-15) (VSP2/ VSP3-o/ 2pVSP4e)  1404 + 2060 + 2452 + 2604 (+/-15) (VSP3)	continuous	infinite	-5 + -5 + -5 (+/-1 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/-1 dB) (VSP3)
negative acknowledge	xcg/nack	450 (+/- 15)	0.12 on, 0.12 off	60	-8 (+/- 1 dB)
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	425 (+/- 5)	1.0 on. 0.25 off (+/- 0.05)	20	-4.5
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	425 (+/- 5)	0.04 on, 0.04 off (+/-0.005)	1 cycle	-4.5
held	srvtn/ht	1400 (+/- 50)	0.4 on, 15 off (+/- 10%)	infinite	-15 (+/- 2 dB)
message waiting	srvtn/mwt	425 (+/- 5)	(0.1 on, 0.1 off) x 10 then continuous	20	-4.5
(2 of 2)					

## Brazil

### Definition of supported tones for Brazil

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 25 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 0.5 dB)
dial	cg/dt	425	continuous	20	-15
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-15
busy	cg/bt	425	0.25 on, 0.25 off repeated	infinite	-10
congestion	cg/ct	425	0.5 on, 0.5 off	infinite	-10
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- -50)	0.33 (f1) on (+/- 0.04), 0.33 (f2) on (+/- 0.04), 0.33 (f3) on (+/- 0.04), 1 off (+/- 0.1)	1 cycle	-10/ -10/ - 10 (+/- 1.5 dB)
warning	cg/wt	392 (f1) 494 (f2) 587 (f3)	0.5 (f1) on, 0.5 (f2) on, 1.5 (f3) on	1 cycle	-17/ -17/ - 17
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425	0.06 on, 0.25 traffic, 0.06 on	1 cycle	-10
caller waiting	cg/cr	425	0.4 on, 5.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-15

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Definitions of audible tones by country

Definition of supported tones for Brazil (continued)

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 25 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 0.5 dB)
off-hook warning	xcg/roh	1400 + 2066 + 2600 (+/-1%) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2066 + 2467 + 2600 (+/-1%) (VSP3)	0.1 on, 0.1 off	infinite	-6 + -6 + -6 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	425	0.1 on, 0.1 off	60	-10
vacant number	xcg/vac	425	0.25 on, 0.25 off, 0.75 on, 0.25 off	infinite	-10
special conditions dial tone	xcg/spec	425	(0.1 on, 0.1 off) x3, 19.4 on	20	-10
recall dial tone	srvtn/rdt	425	continuous	20	-15
confirmation	srvtn/conf	425	0.1 on, 0.1 off, 0.25 on, 0.1 off	15	-10
held	srvtn/ht	Not requested or defined for Brazil. If necessary, map with ITU E.180			
message waiting	srvtn/mwt	425	0.1 on, 0.1 off	20	-10

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## Brazil Custom 1

### Definition of supported tones for Brazil Custom 1

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 25 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 0.5 dB)
dial	cg/dt	425	continuous	20	-15
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-15
busy	cg/bt	425	0.25 on, 0.25 off repeated	infinite	-10
congestion	cg/ct	425	0.5 on, 0.5 off	infinite	-10
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- -50)	0.33 (f1) on (+/- 0.04), 0.33 (f2) on (+/- 0.04), 0.33 (f3) on (+/- 0.04), 1 off (+/- 0.1)	1 cycle	-10/ -10/ - 10 (+/- 1.5 dB)
warning	cg/wt	392 (f1) 494 (f2) 587 (f3)	0.5 (f1) on, 0.5 (f2) on, 1.5 (f3) on	1 cycle	-17/ -17/ - 17
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425	0.06 on, 0.25 traffic, 0.06 on	1 cycle	-10
caller waiting	cg/cr	425	0.4 on, 5.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	425	0.5on 2.5off	infinite	-10

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Definitions of audible tones by country

**Definition of supported tones for Brazil Custom 1 (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 25 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 0.5 dB)
off-hook warning	xcg/roh	1400 + 2066 + 2600 (+/-1%) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2066 + 2467 + 2600 (+/-1%) (VSP3)	0.1 on, 0.1 off	infinite	-6 + -6 + -6 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	425	0.1 on, 0.1 off	60	-10
vacant number	xcg/vac	425	0.25 on, 0.25 off, 0.75 on, 0.25 off	infinite	-10
special conditions dial tone	xcg/spec	425	(0.1 on, 0.1 off) x3, 19.4 on	20	-10
recall dial tone	srvtn/rdt	425	continuous	20	-15
confirmation	srvtn/conf	425	0.1 on, 0.1 off, 0.25 on, 0.1 off	15	-10
held	srvtn/ht	Not requested or defined for Brazil. If necessary, map with ITU E.180			
message waiting	srvtn/mwt	425	0.1 on, 0.1 off	20	-10

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## Canada

### Definition of supported tones for Canada

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s)	Level (dBm) (+/- 1.5 dB)
dial	cg/dt	350 + 440 (+/- 0.5%)	continuous	20 (+/- 10%)	-13 + -13 (+/- 1.5 dB)
(audible) ringing	cg/rt	440 + 480 (+/- 0.5%)	2.0 on, 4.0 off (+/- 10%)	infinite	-19 + -19 (+/- 1.5 dB)
busy	cg/bt	480 + 620 (+/- 0.5%)	0.5 on, 0.5 off (+/- 10%)	infinite	-24 + -24 (+/- 1.5 dB)
congestion	cg/ct	480 + 620 (+/- 0.5%)	0.25 on, 0.25 off (+/- 10%)	infinite	-24 + -24 (+/- 1.5 dB)
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50 Hz)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on 1.0 off (+/- 10%)	1 cycle	-24/-24/- 24 (+/- 1.5 dB)
warning	cg/wt	1400 (+/- 1.5%)	0.5 on (+/- 10%)	1 cycle	-7 (+/- 1.5 dB)
pay phone recognition	cg/prt	1100 (f1) 750 (f2)	(0.2 (f1) on 0.2 (f1) off, 0.2 (f2) on 2.0 traffic) x 5	13	-6 (f1) -7 (f2)
call waiting	cg/cw	440 (+/- 0.5%)	0.3 on (+/- 10%)	1 cycle	-13 (+/- 1.5dB)
caller waiting	cg/cr	440 + 480 (f1) 440 (f2)	2.0 (f1) 0.3 (f2) 3.7 off (repeating)	infinite	f1 = -19 + -19 f2 = -13
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Canada (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s)	Level (dBm) (+/- 1.5 dB)
off-hook warning	xcg/roh	1400 + 2060 + 2600 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 2%)  1400 + 2060 + 2450 + 2600 (VSP3) (+/- 2%)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (+/- 1.5dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/- 1.5dB) (VSP3)
negative acknowledge	xcg/nack	480 + 620	0.25 on, 0.25 off (repeating)	infinite	-24 + -24
vacant number	xcg/vac	map to cg/ct		infinite	
special conditions dial tone	xcg/spec	map to cg/dt			
recall dial tone	srvtn/rdt	350 + 440 (+/- 0.5%)	(0.1 on, 0.1 off) x 3, then continuous (+/- 10%)	20 (+/- 10%)	-13 + -13 (+/- 1.5dB)
confirmation	srvtn/conf	350 + 440 (+/- 0.5%)	0.1 on, 0.1 off (+/- 10%)	3 cycles	-13 + -13 (+/- 1.5dB)
held	srvtn/ht	620	0.25 on, 0.25 off, 0.25 on, 3.25 off (repeating)	infinite	-24
message waiting	srvtn/mwt	350 + 440 (+/- 0.5%)	(0.1 on, 0.1 off) x 10, then continuous (+/- 10%)	20 (+/-10%)	-13 + -13 (+/- 1.5dB)
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**Definition of supported tones for Canada (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1.5 dB)
carrier dial	carr/cdt	400 (+/- 0.5%)	continuous	20 (+/- 10%)	-10 (+/- 1.5 dB)
carrier answer	carr/ans	silence (no frequency), signal complete immediate			
carrier charging	carr/chg	silence (no frequency), signal complete immediate			
long distance indicator	carr/ldi	silence (no frequency), signal complete immediate			
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## Chile

### Definition of supported tones for Chile

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400 (+/- 2.5%)	continuous	20	-10 (+/- 5)
(audible) ringing	cg/rt	400 (+/- 2.5%)	1.0 on, 3.0 off	infinite	-10 (+/- 5)
busy	cg/bt	400 (+/- 2.5%)	0.5 on, 0.5 off	infinite	-10 (+/- 5)
congestion	cg/ct	400 (+/- 2.5%)	0.2 on, 0.2 off	infinite	-10 (+/- 5)
special information	cg/sit	950 (f1)/ 1400 (f2)/ 1800 (f3) (+/- 50)	0.333 f1 on, 0.333 f2 on, 0.333 f3 on, 1.0 off	1 cycle	-10/ -10/ - 10 (+/- 5)
warning	cg/wt	1400	0.5 on	1 cycle	-10 (+/- 5)
pay phone end of period	cg/prt	1400 (+/- 2.5%)	0.5 on	1 cycle	-10 (+/- 5)
call waiting	cg/cw	400	0.3 on	1 cycle	-10 (+/- 5)
caller waiting	cg/cr	400	(0.1 on 0.1 off) x 2; 0.6 on, 3.0 off	infinite	-10 (+/- 5)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
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Definitions of audible tones by country

**Definition of supported tones for Chile (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2450 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 2%)  1400 + 2060 + 2450 + 2600 VSP3 only) (+/- 2%)	0.1 on, 0.1 off	infinite	-3.5 + -3.5 + -3.5 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 1.5 dB)  -5 + -5 + -5 + -5 (VSP3) (+/- 1.5 dB)
negative acknowledge	xcg/nack	400 (+/- 2.5%)	0.2 on, 0.2 off	60	-10 (+/- 5)
vacant number	xcg/vac	1000/1400/ 1800	0.33/0.33/ 0.33 on, 1.0 off	infinite	-10/-10/-10 (+/- 5)
special conditions dial	xcg/spec	425	(0.1 on, 0.1 off) x 3, 19.4 on	20	-10
recall dial tone	srvtn/rdt	400 (+/- 2.5%)	continuous	20	-10 (+/- 5)
confirmation	srvtn/conf	400	0.17 on, 0.14 off, 0.34 on	1 cycle	-10 (+/- 5)
held	srvtn/ht	400	0.05 on, 2.0 off	infinite	-10 (+/- 5)
message waiting	srvtn/mwt	400	(0.16 on, 0.16 off) x 10, then on continuous	20	-10 (+/- 5)
(2 of 2)					

## China

### Definition of supported tones for China

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm) (+/- 3)
dial	cg/dt	450 (+/- 25)	continuous	10	-10
(audible) ringing	cg/rt	450 (+/- 25)	1.0 on, 4.0 off	infinite	-10
busy	cg/bt	450 (+/- 25)	0.35 on, 0.35 off	infinite	-10
congestion	cg/ct	450 (+/- 25)	0.7 on, 0.7 off	infinite	-10
special information	cg/sit	950 (+/- 50)	0.4 on, 10.0 off	1 cycle	-20
warning	cg/wt	450 (+/- 25)	0.2 on, 0.2 traffic, 0.2 on,	1 cycle	-20
pay phone recognition	cg/prt	1633 (f1) 1366 (f2)	0.2 (f1) on 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	450 (+/- 25)	0.4 on	1 cycle	-20
caller waiting	cg/cr	450 (+/- 25)	1.0 on, 4.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	950 (+/- 50)	increasing loudness in 4 phases:  -25 dB for 15 s, -18 dB for 15 s, -9 dB for 15 s, 0 dB for 15 s	infinite	see values at Cadence.

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Definitions of audible tones by country

**Definition of supported tones for China (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm) (+/- 3)
negative acknowledge	xcg/nack	450 (+/- 25)	0.7 on, 0.7 off	60	-10
vacant number	xcg/vac	450 (+/- 25)	(0.1 on, 0.1 off) x 3, 0.4 on 0.4 off	infinite	-10
special conditions dial	xcg/spec	450 (+/- 25)	0.4 on, 0.04 off	60	-10
recall dial	srvt/rdt	450 (+/- 25)	continuous	10	-10
confirmation	srvt/conf	950 (+/- 50)	continuous	2	-20
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	450 (+/- 25)	0.4 on, 0.04 off	60	-10

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## Czech Republic

### Definition of supported tones for the Czech Republic

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425 (+/- 10%)	0.33 on, 0.33 off, 0.66 on 0.66 off all +/- 10%	20	-5 (+/- 1)
(audible) ringing	cg/rt	425 (+/- 10%)	1.0 on, 4.0 off all +/- 10%	infinite	-5 (+/- 1)
busy	cg/bt	425 (+/- 10%)	0.33 on, 0.33 off all +/- 10%	infinite	-5 (+/- 1)
congestion	cg/ct	425 (+/- 10%)	0.165 on, 0.165 off all +/- 10%	infinite	-5 (+/- 1)
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, 1.0 off	1 cycle	-5/ -5/ -5
warning	cg/wt	1400	0.5 on	1 cycle	-5
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-5/ -5
call waiting	cg/cw	425 (+/- 10%)	0.33 on +/-0.03	1 cycle	-5 (+/- 1)
caller waiting	cg/cr	425 (+/- 10%)	1.0 on (+/- 0.1), 0.170 off (+/- 0.03), 0.33 on (+/- 0.03), 3.5 off (+/- 0.3)	infinite	-5 (+/- 1)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
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Definitions of audible tones by country

**Definition of supported tones for the Czech Republic (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	1400 + 2060 + 2600 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 2%)  1400 + 2060 + 2450 + 2600 (VSP3) (+/- 2%)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (+/-1.5 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/-1.5 dB) (VSP3)
negative acknowledge	xcg/nack	425 (+/- 10%)	0.165 on, 0.165 off all +/- 10%	60	-5 (+/- 1)
vacant number	xcg/vac	950 (f1) 1400 (f2) 1800 (f3) all +/- 10%	0.33 (f1) on (+/- 0.07), 0.03 off, 0.33 (f2) on (+/- 0.07), 0.03 off, 0.33 (f3) on (+/- 0.07), 1.0 off (+/- 0.25)	infinite	-5 + -5 + -5 (+/- 1 dB)
special conditions dial tone	xcg/spec	425 (+/- 10%)	(0.165 on, 0.165 off) x 3, 0.66 on, 0.66 off, (+/- 0.016)	20	-5 (+/- 1)
recall dial tone	srctn/rdt	425 (+/- 10%)	0.33 on, 0.33 off 0.66 on, 0.66 off all +/- 10%	20	-5 (+/- 1)
(2 of 3)					

Definitions of audible tones by country

**Definition of supported tones for the Czech Republic (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
confirmation	srvtn/conf	351 + 439 (+/- 2%)	0.1 on, 0.1 off, 0.3 on, 0.1 off	1 cycle	-10 + -10 (+/- 2 dB)
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	400 + 425 (+/- 7 Hz)	continuous	20	-6 + -6
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## France

### Definition of supported tones for France

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s) (+/-10%)	Duration (s) (+/-10%)	Level (dBm)
dial	cg/dt	440 (+/- 2)	continuous	20	-3.5 (+/- 0.5 dB)
(audible) ringing	cg/rt	440 (+/- 2)	1.5 on, 3.5 off	infinite	-11 (+/- 2 dB)
busy	cg/bt	440 (+/- 2)	0.5 on, 0.5 off	infinite	-11 (+/- 2 dB)
congestion	cg/ct	440 (+/- 2)	0.5 on, 0.5 off	infinite	-11 (+/- 2 dB)
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.3 (f1) on, 0.03 off, 0.3 (f2) on, 0.03 off, 0.3 (f3) on, 1.0 off	1 cycle	-10/-10/- 10 (+/- 2 dB)
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.18 on (+/- 0.02)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-20/-20 (+/-2 dB)
call waiting	cg/cw	440 (+/- 2)	0.3 on (+/- 0.05)	1 cycle	-11 (+/- 2 dB)
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	440 (+/- 2)	0.05 on, 0.05 off	infinite	-11 (+/- 2 dB)

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Definitions of audible tones by country

**Definition of supported tones for France (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s) (+/-10%)	Duration (s) (+/-10%)	Level (dBm)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (+/-15) (VSP2/ VSP3-o/ 2pVSP4e)  1404 + 2060 + 2452 + 2604 (+/- 15) (VSP3)	continuous	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e) (+/-1 dB)  -6 + -6 + -6 + -6 (VSP3) (+/-1 dB)
negative acknowledge	xcg/nack	450 (+/- 15)	0.12 on, 0.12 off	60	-8 (+/- 1 dB)
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	440 (+/- 2)	continuous	20	-11 (+/- 2 dB)
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	450 (+/- 15)	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-8 (+/- 1 dB)
held	srvtn/ht	440 (+/- 2)	0.2 on, 0.2 off, 0.2 on, 5.0 off	infinite	-11 (+/- 2 dB)
message waiting	srvtn/mwt	440 (+/- 2)	(0.1 on, 0.1 off) x 10 then continuous	20	-3.5 (+/- 0.5 dB)
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## Germany

### Definition of supported tones for Germany

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
dial	cg/dt	425 (+/- 7)	continuous	20	-3
(audible) ringing	cg/rt	425 (+/- 7 Hz)	1 on, 4 off (+/- 8%)	infinite	-3
busy	cg/bt	425 (+/- 7)	0.48 on, 0.48 off (+/- 3%)	infinite	-3
congestion	cg/ct	425 (+/- 7)	0.24 on, 0.24 off (+/- 3%)	infinite	-3
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1.0 off (+/- 0.25)	1 cycle	-3/ -3/ -3
warning	cg/wt	1400 (+/- 1.5%)	0.5 on (+/- 10%)	1 cycle	-34 (+/- 1.5 dB)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-9/ -9
call waiting	cg/cw	425 (+/- 7)	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-9
caller waiting	cg/cr		cg/rt for 30 (+/- 10%) followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal completed immediate			

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Definitions of audible tones by country

**Definition of supported tones for Germany (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
comfort	xcg/cmft	undefined. nothing played signal complete immediately			
off-hook warning	xcg/roh	1400 + 2066 + 2600 (+/-2%) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2066 + 2450 + 2600 (+/-2%) (VSP3)	0.1 on, 0.1 off	infinite	-5+ -5 + -5 (+/-2 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/-2 dB) (VSP3)
negative acknowledge	xcg/nack	425 (+/- 15)	0.12 off, 0.12 on	60	-3
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	400 + 425 (+/- 7)	continuous	20	-6 + -6
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	425 (+/- 7)	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-3
held	srvtn/ht	425 (+/- 7)	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-3
message waiting	srvtn/mwt	425 (+/- 7)	(0.1 on, 0.1 off) x 10 then continuous	20	-3
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## Greece

### Definition of supported tones for Greece

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	0.2 on, 0.3 off 0.7 on, 0.8 off	20	-10
(audible) ringing	cg/rt	425	1.0 on, 4 off	infinite	-10
busy	cg/bt	425	0.3 on, 0.3 off	infinite	-13
congestion	cg/ct	425	0.15 on, 0.15 off	infinite	-11
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.333 (f1) on, 0.333 (f2) on, 0.333 (f3) on, 1.0 off	1 cycle	-10/ -10/ - 10
warning	cg/wt	1400	0.5 on	1 cycle	-34
pay phone recognition	cg/prt,	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-13/ -13
call waiting	cg/cw	425	0.3 on	1 cycle	-13
caller waiting	cg/cr	425	1.0 on, 4.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
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Definitions of audible tones by country

**Definition of supported tones for Greece (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2450 (+/-15) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2060 + 2450 + 2600 (+/- 15) (VSP3)	0.1 on, 0.1 off	infinite	-3.5 + -3.5 + -3.5 (+/-1.5 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -5 + -5 + -5 +5 (+/-1.5 dB) (VSP3)
negative acknowledge	xcg/nack	425	0.15 on, 0.15 off	60	-11
vacant number	xcg/vac	450	continuous	infinite	-13
special conditions dial tone	xcg/spec	400 (f1) 425 (f2)	0.2 (f1) on, 0.3 off, 0.7 (f2) on, 0.8 off	20	-10 (f1) / -10 (f2) (+/- 2 dB)
recall dial tone	srvtn/rdt	425	0.2 on, 0.3 off, 0.7 on, 0.8 off	20	-10
confirmation	srvtn/conf	450 (+/- 5%)	0.04 on, 0.04 off	1 cycle	-9.8 (+/- 0.4)
held	srvtn/ht	900	0.5 on, 0.5 off	infinite	-10
message waiting	srvtn/mwt	400 (f1) 425 (f2)	0.2 (f1) on, 0.3 off, 0.7 (f2) on, 0.8 off	20	-10 (f1) / -10 (f2) (+/- 2 dB)
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## Hong Kong

### Definition of supported tones for Hong Kong

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	350 + 440	continuous	20	-13 + -13 (+/- 5 dB)
(audible) ringing	cg/rt	440 + 480	0.4 on, 0.2 off, 0.4 on, 3.0 off	infinite	-13 + -13 (+/- 5 dB)
busy	cg/bt	480 + 620	0.5 on, 0.5 off	infinite	-13 + -13 (+/- 5 dB)
congestion	cg/ct	480 + 620	0.25 on, 0.25 off	infinite	-13 + -13 (+/- 5 dB)
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3) (+/- 50)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, 1.0 off (+/- 10%)	1 cycle	-10/ -10/ - 10 (+/- 5 dB)
warning	cg/wt	440	1.0 on	1 cycle	-13 (+/- 1)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-13/ -13 (+/- 1)
call waiting	cg/cw	440	0.5 on, 0.5 traffic, 0.5 on, 0.5 traffic, 0.5 on	1 cycle	-13 (+/- 1)
caller waiting	cg/cr	mapped to cg/rt		infinite	
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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**Definition of supported tones for Hong Kong (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2450 (+/- 2%) (VSP2/ VSP3-o/ 2pVSP4e only)  1400 + 2060 + 2450 + 2600 (+/- 2%) (VSP3)	0.1 on, 0.1 off	infinite	-3.5 + -3.5 + -3.5 (+/- 1.5 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -5 + -5 + -5 + -5 (+/- 1.5dB) (VSP3)
negative acknowledge	xcg/nack	mapped to cg/ct		60	
vacant number	xcg/vac	480 + 620	continuous	infinite	-13 + -13 (+/- 5 dB)
special conditions dial tone	xcg/spec	350 + 440	(0.1 On, 0.1 Off) for 4 seconds, followed by continuous tone	20	-16 + -16 (+/- 5 dB)
recall dial tone	srvtn/rdt	350 + 440	(0.1 on, 0.1 off) x 3, followed by continuous tone	20	-16 + -16 (+/- 5 dB)
confirmation	srvtn/conf	350 + 440	0.1 on, 0.1 off, 0.3 on, 0.3 off	1 cycle	-16 + -16 (+/- 5 dB)
(2 of 3)					

**Definition of supported tones for Hong Kong (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
held	srvtn/ht	350 + 440	0.5 on, 2.5 off	infinite	-16 + -16 (+/-5 dB)
message waiting	srvtn/mwt	350 + 440	(0.2 on, 0.2 off, 0.5 on, 0.2 off) x 4, followed by continous tone	20	-16 + -16 (+/- 5 dB)

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## India

### Definition of supported tones for India

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400 modulated by 25 at 100% depth	continuous	20	-10 (+/- 5)
(audible) ringing	cg/rt	400 modulated by 25 at 100% depth	0.4 on, 0.2 off, 0.4 on, 2.0 off (repeated)	infinite	-10 (+/- 5)
busy	cg/bt	400	0.75 on, 0.75 off (repeated)	infinite	-10 (+/- 5)
congestion	cg/ct	400	0.25 on, 0.25 off (repeated)	infinite	-10 (+/- 5)
special information	cg/sit	400	1.0 on, 4.0 off	infinite	-10 (+/- 5)
warning	cg/wt	800	0.12 on	1 cycle	-10 (+/- 5)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-10/ -10 (+/- 1)
call waiting	cg/cw	400	0.2 on, 0.1 traffic, 0.2 on	1 cycle	-10 (+/- 5)
caller waiting	cg/cr	400 modulated by 25 at 100% depth	0.4 on, 0.2 off, 0.4 on, 2.0 off (repeated)	infinite	-10 (+/- 5)
pay	bcg/bpy	silence. (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for India (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
comfort	xcg/cmft	silence. (no frequency), signal complete immediate			
off-hook warning	international ROH tone	400	continuous	infinite	-10
negative acknowledge	xcg/nack	400	0.25 on, 0.25 off	60	-10 (+/- 5)
vacant number	xcg/vac	400	2.8 on, 0.2 off	infinite	-10 (+/- 5)
special conditions dial tone	xcg/spec	400 + 300	continuous	20	-13 + -13 (+/- 5)
recall dial tone	srvtn/rdt	400 modulated by 25 at 100% depth	continuous	20	-10 (+/- 5)
confirmation	srvtn/conf	400	1.0 on, 4.0 off	1 cycle	-10 (+/- 5)
held	srvtn/ht	400	0.25 on, 0.25 off, 0.25 on, 3.25 off (repeated)	infinite	-10 (+/- 5)
message waiting	srvtn/mwt	400 + 300	continuous	20	-13 + -13 (+/- 5)
(2 of 2)					

## Ireland

### Definition of supported tones for Ireland

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
dial	cg/dt	425	continuous	20	-12
(audible) ringing	cg/rt	425	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-10
busy	cg/bt	425 (+/- 15)	0.5 on, 0.5 off	infinite	-12
congestion	cg/ct	mapped to cg/bt			
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	1.0 off (+/- 0.25), 0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07)	1 cycle	-13/ -13/ - 13
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.18 on (+/- 0.02)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1100+1750 (f1) 750 + 1450 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-23 + -23 / -23 + -23
call waiting	cg/cw	400	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-13
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence. (no frequency), signal complete immediate			
comfort	xcg/cmft	425 (+/- 5)	0.06 on, 0.06 off	infinite	-13

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Definitions of audible tones by country

**Definition of supported tones for Ireland (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
off-hook warning	xcg/roh	1400 + 2067 + 2600 (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2067 + 2467 + 2600 (VSP3)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	mapped to xcg/vac			
vacant number	xcg/vac	400	continuous	infinite	-7
special conditions dial tone	xcg/spec	mapped to cd/dt			
recall dial tone	srvtn/rdt	400	continuous	20	-7
confirmation	srvtn/conf	425	0.2 on, 0.1 off	1 cycle	-10
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	400 (f1) 440 (f2)	0.32 (f1), 0.04 (f2)	20	-13/ -13
(2 of 2)					

## Israel

### Definition of supported tones for Israel

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400	continuous	20	-6
(audible) ringing	cg/rt	400	1.0 on, 3.0 off	infinite	-6
busy	cg/bt	400	0.5 on, 0.5 off	infinite	-6
congestion	cg/ct	400	0.25 on, 0.25 off	infinite	-6
special information	cg/sit	1000 (f1) 1400 (f2) 1800 (f3)	0.333 (f1) on, 0.3333 (f2) on 0.333 (f3) on, 1.0 off	1 cycle	-6 + -6 + -6
warning	cg/wt	1400	0.425 on	1 cycle	-6
pay phone recognition	cg/prt	1209 (f1) 852 (f2)	0.2 (f1) on, 0.2 traffic 0.2 (f2) on	1 cycle	-6/ -6
call waiting	cg/cw	400	0.3 on	1 cycle	-10
caller waiting	cg/cr	400	(0.1 on, 0.1 off) x 2, 0.6 on, 3.0 off	infinite	-6
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Israel (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2600 (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2060 + 2450 + 2600 (VSP3)	0.12 on, 0.08 off	infinite	-6 + -6 + -6 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	cg/nack	1000 (f1) 1400 (f2) 1800 (f3)	0.333 (f1) on, 0.3333 (f2) on 0.333 (f3) on, 1.0 off	60	-6/ -6/ -6
vacant number	xcg/vac	1000 (f1) 1400 (f2) 1800 (f3)	0.333 (f1) on, 0.3333 (f2) on 0.333 (f3) on, 1.0 off	infinite	-6/ -6/ -6
special conditions dial tone	xcg/spec	400	(0.1 on, 0.1 off) x 3 followed by cg/dt	20	-6
recall dial tone	srvtn/rdt	400	continuous	20	-6
confirmation	srvtn/conf	400	0.17 on, 0.17 off, 0.34 on	1 cycle	-6
held	srvtn/ht	400	0.05 on, 2.0 off	infinite	-16
message waiting	srvtn/mwt	400	(0.16 on, 0.16 off) x 10 followed by cg/dt	20	-6

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## Italy

### Definition of supported tones for Italy

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1 dB)
dial	cg/dt	425	continuous	20	-15
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-25
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-25
congestion	cg/ct	425	(0.2 on, 0.2 off) x 2 0.2 on, 0.6 off (+/- 5%)	infinite	-25
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on 0.01 off, 0.33 (f2) on 0.01 off, 0.33 (f3) on 1.0 off	1 cycle	-23/ -23/ - 23
toneburst on answer (replaces warning tone)	cg/wt	1111 +/- 5%	0.18 on (+/- 20)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-20/ -20 (+/- 2 dB)
call waiting	cg/cw	425	1.0 on	1 cycle	-13
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-15

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Definitions of audible tones by country

**Definition of supported tones for Italy (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15 Hz)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (VSP2/ VSP3-o/ 2pVSP4e)  1404 + 2060 + 2452 + 2604 (VSP3)	continuous	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	450 (+/- 15)	0.12 on, 0.12 off	60	-8
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	425	1.0 on, 0.1 off (+/- 5%)	20	-15
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	450 (+/- 15)	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-8
held	srvtn/ht	450 (+/- 15)	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-8
message waiting	srvtn/mwt	425	(0.1 on, 0.1 off) x 10 then continuous	20	-15
(2 of 2)					

## Japan

### Definition of supported tones for Japan

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400	continuous	60	-16
(audible) ringing	cg/rt	400 modulated by 16 at 85% depth	1.0 on, 2.0 off	infinite	-5
busy	cg/bt	400	0.5 on, 0.5 off	infinite	-5
congestion	cg/ct	400	0.5 on, 0.5 off	infinite	-5
special information	cg/sit	400	0.5 on	1 cycle	-16
warning	cg/wt	1400	0.35 to 0.5 on	1 cycle	-34 (+/- 1.5 dB)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic 0.2 (f2) on	1 cycle	-13/ -13, (+/- 2 dB)
call waiting	cg/cw	(f1) 400 modulated by 16 at 85% depth  (f2) 400	f1: 0.5 on, 0.0 to 4.0 traffic  f2: 0.05 on, 0.45 traffic, 0.05 on, 3.45 traffic	f1 for 0.5 to 4.5 once followed by f2 for 4.0  1 cycle	-12/ -12
caller waiting	cg/cr	400 modulated by 16 at 85% depth	1.0 on 2.0 off	infinite	-5
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Japan (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	400	a tone that increases loudness during first 3 or 15 period	infinite	+36 at steady condition
negative acknowledge	xcg/nack	400	0.5 on, 0.5 off	60	-5
vacant number	xcg/vac	400	0.5 on, 0.5 off	infinite	-5
special conditions dial tone	xcg/spec	400	0.15 on 0.1 off	60	-16
recall dial tone	srvtn/rdt	400	continuous  0.125 on 0.125 off	60	-16
confirmation	srvtn/conf	400	0.125 on, 0.125 off, 0.125 on, 0.625 off	repeated	-16
held	srvtn/ht	(f1) 400 modulated by 16 at 85% depth  (f2) 400	f1: 0.5 on, 0.5 off  f2: 0.5 on, 2.5 off	infinite	-12/ -12
message waiting	srvtn/mwt	400	0.15 on, 0.1 off	60	-16
(2 of 2)					

## Japanese fire and police trucks (JFPT)

The supported tones for Japanese fire and police trucks (JFPT) are the same as in the [Definition of supported tones for Japan \(page 225\)](#) with the exception of the following definition in [Definition of supported tones for JFPT \(exception to supported tones for Japan\) \(page 227\)](#).

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**Attention:** JFPT tones are only supported by VSP3-o (not supported by VSP2, VSP3, or VSP4e).

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### Definition of supported tones for JFPT (exception to supported tones for Japan)

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
(audible) ringing	cg/rt	400 modulated by 16 at 85% depth	continuous	infinite	-5

## Korea

### Definition of supported tones for Korea

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	350 + 440	continuous	16	-10 + -10
(audible) ringing	cg/rt	440 + 480	1.0 on, 2.0 off	infinite	-15 + -15
busy	cg/bt	480 + 620	0.5 on, 0.5 off	infinite	-20 + -20
congestion	cg/ct	480 + 620	0.3 on, 0.2 off	infinite	-20 + -20
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on 1.0 off	1 cycle	-10/ -10/ - 10
warning	cg/wt	397 (f1) 494 (f2) 587 (f3)	0.5 (f1) on, 0.5 (f2) on 1.5 (f3) on,	1 cycle	-10/ -10/ - 10
pay phone recognition	cg/prt,	1633 (f1) 1336(f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycles	-10/ -10
call waiting	cg/cw	350 + 440	0.25 on, 0.25 traffic, 0.25 on	1 cycle	-10 + -10
caller waiting	cg/cr	440 + 480	1.0 on, 2.0 off	infinite	-15 + -15
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
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Definitions of audible tones by country

Definition of supported tones for Korea (continued)

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2600 (+/-2%) (VSP2/ VSP3-o/ 2pVSP4e)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e) (+/-1.5 dB)  -6 + -6 + -6 + -6 (VSP3) (+/-1.5 dB)
negative acknowledge	xcg/nack	480 + 620	0.3 on, 0.2 off	60	-20 + -20
vacant number	xcg/vac	480 + 620	0.3 on, 0.2 off	infinite	-20 + -20
special conditions dial tone	xcg/spec	397 (f1) + 494 (f2) + 587 (f3)	0.25 on, - 0.25 off, 0.25 on, 32.5 off	1 cycle	-10 + -10 + -10
recall dial tone	srvtn/rdt	350 + 440	1.0 on, 0.25 off	15	-10 + -10
confirmation	srvtn/conf	397 (f1) + 494 (f2) + 587 (f3)	0.25 on, 0.25 off, 0.25 on, 32.5 off	1 cycle	-10 + -10, + -10
held	srvtn/ht	440 (f1) + 480(f2) + 350(f3)	0.5 (f1 + f2) on 0.5 off, 0.5 (f1 + f3) on, 2.5 off	infinite	(-10 + -10)/ (-10 + -10)
message waiting	srvtn/mwt	397 (f1) + 494 (f2) + 587 (f3)	0.25 on, 0.25 off, 0.25 on, 32.5 off	1 cycle	-10 + -10 + -10
(2 of 2)					

## Malaysia

### Definition of supported tones for Malaysia

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm) (+/- 3)
dial	cg/dt	425	continuous	20	-12
(audible) ringing	cg/rt	425	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-12
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-12
congestion	cg/ct	425	0.25 on, 0.25 off	infinite	-12
special information	cg/sit	900 (f1) 1400 (f2) 1800 (f3)	1.0 (f1) on, 1.0 (f2) on, 1.0 (f3) on, 1.0 off	infinite	-19/ -19/ - 19
warning	cg/wt	900	0.1 on, 0.1 traffic, 0.1 on, 0.1 traffic, 0.1 on	1 cycle	-19
pay phone recognition	cg/prt	1400 (f1), 950 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-8/ -8 (+/- 2)
call waiting	cg/cw	425	0.5 on, 0.25 traffic, 1.0 on	1 cycle	-12
caller waiting	cg/cr	425	0.4 on, 0.2 off, 0.4 on, 0.2 off, 0.1 on, 0.2 off, 0.1 on, 1.6 off	infinite	-12

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Definitions of audible tones by country

**Definition of supported tones for Malaysia**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm) (+/- 3)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	3200	continuous	infinite	-8 (+/- 2 dB)
negative acknowledge	xcg/nack	425	continuous	60	-12 (+/- 2)
vacant number	xcg/vac	425	2.5 on, 0.5 off	infinite	-12
special conditions dial tone	xcg/spec	425	0.25 on, 0.25 off, 0.25 on, 0.25 off	20	-12
recall dial tone	srvtn/rdt	425	continuous	20	-12
confirmation	srvtn/conf	425	0.06 on, 0.06 off	1 cycle	-12 (+/- 2)
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425	0.16 on, 0.16 off	20	-8 (+/- 2)
(2 of 2)					

## Mexico

### Definition of supported tones for Mexico

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	continuous	15	-10
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-10
busy	cg/bt	425	0.50 on, 0.50 off	infinite	-10
congestion	cg/ct	425	0.25 on, 0.25 off	infinite	-10
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3) (+/- 50)	0.33 (f1) (+/- 0.07), 0.33 (f2) (+/- 0.07), 0.33 (f3) (+/- 0.07), 1.03 off (+/- 0.25)	1 cycle	-10/ -10/ - 10
warning	cg/wt	1400 (+/- 1.5%)	0.5 on	1 cycle	-10
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425	0.2 on,	1 cycle	-10
caller waiting	cg/drwc	425	0.1 on, 0.4 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Mexico (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2067 + 2600 (VSP2/ VSP3-o/ 2pVSP4e only)  1400 + 2067 + 2467 + 2600 (VSP3 only)	0.1 on, 0.1 off	infinite	-6 (1400 Hz) -5 (2067 Hz) -6 (2600 Hz) (VSP2/ VSP3-o/ 2pVSP4e)  -6 (1400 Hz) -5 (2067 Hz) -6 (2467 Hz) -6 (2600 Hz) (VSP3) only)
negative acknowledge	xcg/nack	425	0.12 on, 0.12 off	60	-10
vacant number	xcg/vac	425	0.25 on, 0.25 off	infinite	-10
special conditions dial	xcg/spec	425	0.4 on, 0.04 off	15	-10
recall dial tone	srvtn/rdt	425	continuous	20	-10
confirmation	srvtn/conf	425	0.1 on, 0.1 off, 0.2 on	1 cycle	-10
held	srvtn/ht	425	0.2 on, 0.5 off, 0.2 on, 10.0 off	infinite	-10
message waiting	srvtn/mwt	425	0.7 on, 0.04 on 0.4 off	2.5	-10
(2 of 2)					

## Mexico Custom 1

### Definition of supported tones for Mexico Custom 1

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	continuous	15	-10
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-10
busy	cg/bt	425	0.50 on, 0.50 off	infinite	-10
congestion	cg/ct	425	0.25 on, 0.25 off	infinite	-10
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3) (+/- 50)	0.33 (f1) (+/- 0.07), 0.33 (f2) (+/- 0.07), 0.33 (f3) (+/- 0.07), 1.03 off (+/- 0.25)	1 cycle	-10/ -10/ - 10
warning	cg/wt	1400 (+/- 1.5%)	0.5 on	1 cycle	-10
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2)	1 cycle	-10/ -10
call waiting	cg/cw	425	2.0 on	1 cycle	-10
alternate call waiting	cg/cw	425	0.5 on, 0.5 off 0.1 on 0.5 off 0.5 on	1 cycle	-10
caller waiting	cg/drwc	425	1.0 on 4.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
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Definitions of audible tones by country

**Definition of supported tones for Mexico Custom 1 (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2067 + 2600 (VSP2/ VSP3-o/ 2pVSP4e only)  1400 + 2067 + 2467 + 2600 (VSP3 only)	0.1 on, 0.1 off	infinite	-6 (1400 Hz) -5 (2067 Hz) -6 (2600 Hz) (VSP2/ VSP3-o/ 2pVSP4e)  -6 (1400 Hz) -5 (2067 Hz) -6 (2467 Hz) -6 (2600 Hz) (VSP3) only)
negative acknowledge	xcg/nack	425	0.12 on, 0.12 off	60	-10
vacant number	xcg/vac	425	0.25 on, 0.25 off	infinite	-10
special conditions dial	xcg/spec	425	0.4 on 0.04 off	15	-10
recall dial tone	srvtn/rdt	425	continuous	20	-10
confirmation	srvtn/conf	425	0.1 on, 0.1 off, 0.2 on	1 cycle	-10
held	srvtn/ht	425	0.2 on, 0.5 off, 0.2 on, 10.0 off	infinite	-10
message waiting	srvtn/mwt	425	0.3 on, 0.1 off 0.3 on 1.3 off	15	-10
(2 of 2)					

## Netherlands

### Definition of supported tones for the Netherlands

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/- 10%)	Level (dBm)
dial	cg/dt	425 (+/- 15)	continuous	20	-5 (+/- 3 dB)
(audible) ringing	cg/rt	425 (+/- 15)	1.0 on, 4.0 off (+/- 10%)	infinite	-5 (+/- 3 dB)
busy	cg/bt	425 (+/- 15)	0.5 on, 0.5 off (+/- 10%)	infinite	-5 (+/- 3 dB)
congestion	cg/ct	425 (+/- 15)	0.25 on, 0.25 off (+/- 0.012)	infinite	-5 (+/- 3 dB)
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1.0 off (+/- 0.25)	1 cycle	-12.5/ - 12.5/ -12.5 (+/- 2.5 dB)
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.18 on (+/- 20)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1633 (f1)/ 1336 (f2) (+/- 8%)	0.2 (f1), 0.2 traffic, 0.2 (f2)	1 cycle	-20/ -20 (+/- 2 dB)
call waiting	cg/cw	425	0.17 on, 0.17 traffic, 0.17 on	1 cycle	-15 (+/- 2 dB)
caller waiting	cg/cr		cg/rt for 30 (+/-10%) followed by cg/bt for remainder	infinite	

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Definitions of audible tones by country

**Definition of supported tones for the Netherlands (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s) (+/- 10%)	Level (dBm)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	440 (+/- 2%)	0.05 on, 0.05 off (+/-10%)	infinite	-11 (+/- 2 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (+/-15) (VSP2/ VSP3-o)  1404 + 2060 + 2452 + 2604 (+/-15) (VSP3)	continuous	infinite	-5 + -5 + -5 (+/-1 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/-1 dB) (VSP3)
negative acknowledge	xcg/nack	425 (+/- 15)	0.0625 on, 0.0625 off (+/- 10%)	60	-10 (+/- 1 dB)
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	425 (+/- 5)	1.0 on (+/- 0.05), 0.25 off (+/- 0.05)	20	-4.5 (+/- 0.5 dB)
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	425 (+/- 5)	0.04 on, 0.04 off (+/- 0.005)	5	-4.5 (+/- 0.5 dB)
held	srvtn/ht	425 (+/- 5)	0.4 on, 15.0 off (+/- 10%)	infinite	-15 (+/- 2 dB)
message waiting	srvtn/mwt	425 (+/- 15)	(0.1 on, 0.1 off) x 10 then continuous	20	-5 (+/- 3 dB)
(2 of 2)					

## New Zealand

### Definition of supported tones for New Zealand

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400	continuous	20	-9 (+/- 1)
(audible) ringing	cg/rt	400 + 450	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-12 + -12 (+/- 1)
busy	cg/bt	400	0.5 on, 0.5 off	infinite	-9 (+/- 1)
congestion	cg/ct	400	0.25 on, 0.25 off	infinite	-9
special information	cg/sit	1400	continuous	infinite	-11 (+/- 1)
warning	cg/wt	1400	0.5 on	1 cycle	-11 (+/- 1)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	2 cycles	-10/ -10
call waiting	cg/cw	400	0.2 on, 3.0 traffic, 0.2 on, 3.0 traffic, 0.2 on, 3.0 traffic, 0.2 on	1 cycle	-21 (+/- 2)
caller waiting	cg/cr	1400	0.2 on, 0.2 off	infinite	-19 (+/- 1)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	not defined. Signal complete immediately			
off-hook warning	xcg/roh	2500 modulated by 25 at 100% depth	continuous	infinite	-3 (+/- 1)
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for New Zealand (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
negative acknowledge	xcg/nack	400	0.25 on, 0.25 off	infinite	-9
vacant number	xcg/vac	400	0.075 on, 0.1 off, 0.075 on, 0.1 off, 0.075 on 0.1 off 0.075 on, 0.4 off	infinite	-12 (+/- 1)
special conditions dial tone	xcg/spec	400 + 450	0.2 on, 0.4 off 2.0 on, 0.4 off	20	-12 (+/- 1)
recall dial tone	srvtn/rdt	400	0.1 on, 0.1 off, 0.1 on, 0.1 off, 0.1 on, 0.1 off, then continuous	20	-9 (+/- 1)
confirmation	srvtn/conf	1400	continuous	20	-11 (+/- 1)
held	srvtn/ht	400 (f1) 400+450 (f2)	0.5 (f1) on, 0.5 off, 0.5 (f2) on, 2.5 off	infinite	-19 (+/- 2)
message waiting	srvtn/mwt	400	(0.1 on, 0.1 off) for 2.5 seconds, then continuous	20	-12 (+/- 1)
(2 of 2)					

## Panama

### Definition of supported tones for Panama

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	continuous	20	-10 (+/- 5)
(audible) ringing	cg/rt	425	1.2 on, 4.65 off	infinite	-10 (+/- 5)
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-10 (+/- 5)
congestion	cg/ct	425	0.25 on, 0.25 off	infinite	-10 (+/- 5)
special information	cg/sit	425	0.4 on, 0.04 off	5 cycles	-10 (+/- 5)
warning	cg/wt	1400	0.5 on	1 cycle	-10 (+/- 5)
pay phone recognition	cg/prt cg/ pt(ASPEN )	1000 (f1) 1400 (f2)	0.2 (f1) on, 0.2 traffic 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425	0.3 on	1 cycle	-10 (+/- 5)
caller waiting	cg/cr	425	1.2 on, 4.65 off	infinite	-10 (+/- 5)
pay	bcg/bpy (H248 only)	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Panama (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2066 + 2600 (+/-2%) (VSP2/ VSP3-o/ 2pVSP4e only)  1400 + 2066 + 2450 + (+/- 2%) (VSP3)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (+/-1.5 dB) (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (+/-1.5 dB) (VSP3)
negative acknowledge	xcg/nack	425	0.25 on, 0.25 off	60	-10 (+/- 5)
vacant number	xcg/vac	425	(0.12 on, 0.12off) x 2 0.36 on, 0.12 off	infinite	-10 (+/- 5)
special conditions dial tone	xcg/spec	425	continuous	20	-10 (+/- 5)
recall dial tone	srvtn/rdt	4250	continuous	20	-10 (+/- 5)
confirmation	srvtn/conf	425	0.1 on 0.1 off 0.3 on 0.1 off	2 cycles	-10 (+/- 5)
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425	continuous	20	-10 (+/- 5)
(2 of 2)					

## Pakistan

### Definition of supported tones for Pakistan

Tone name		Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	450	continuous	20	-10 +/-5
(audible) ringing	cg/rt	450	0.1 on 0.4 off	infinite	-10+/-5
busy	cg/bt	450	0.25 on, 0.35 off	infinite	-10 +/- 5
congestion	cg/ct	450	0.3 on 0.8 off	20	-13 +/- 5
special information	cg/sit	450(f1) 600 (f2)	1.0 (f1) on, 2.0 off 1.0 (f2) on 2.0 off	infinite	+15+/- 5
warning	cg/wt	1400	0.35 on, 0.15 Traffic	infinite	-12 +/- 5
payphone recognition	cg/prt, cg/ pt(	1633 (f1), 1336 (f2)	2.0 (f1) On, 0.2 Traffic 2.0 (f2) On 2.0 Traffic	5 cycles	-10/-10 +/-1
call waiting	cg/cw	450	0.3 on	1 cycle	-13 +/- 5
caller waiting	cg/cr	450	0.1 on 0.4 off	infinite	-10 +/- 5
pay	bcg/bpy	450(f1), 650(f2)	1.0 (f1) On, 0.5 Off, 1.0 (f2) On, 0.5 Off	infinite	-15 +/- 5
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Pakistan (continued)**

Tone name		Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/cmft	1400+2060 +2600(VS P2/VSP3- o/ 2pVSP4e) (+/- 2%)	0.1 on 0.1 off	infinite	-5+ -5+ -5 (+/-1.5dB)
	xcg/roh	1400+2060 +2450 +2600 (VSP3) (+/- 2%)	0.1 on 0.1 off	infinite	-6+ -6+ -6 + -6 (+/- 1.5dB)
negative acknowledge		1400	0.3 on 0.8 off	infinite	-13 (+/- 5)
vacant number	xcg/vac	450(f1) 600(f2)	0.12 (f1) on 2.0 off 1.0(f2) on 2.0 off	infinite	-15 (+/- 5)
special conditions dial tone	xcg/spec	450	continuous	20	-10 (+/- 5)
recall dial tone	srvtn/rdt	450	continuous	20	-10 (+/- 5)
confirmation	srvtn/conf	silence (no frequency), signal complete immediate			
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	450	continuous	20	-10 (+/- 5)
(2 of 2)					

## Philippines

### Definition of supported tones for the Philippines

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	continuous	20	-12 (+/- 1)
(audible) ringing	cg/rt	425	1.75 on, 3.25 off	infinite	-12 (+/- 1)
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-10 (+/- 1)
congestion	cg/ct	425	0.2 on, 0.2 off	infinite	-10 (+/- 1)
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, 1.0 off	infinite	-10/ -10/ - 10 (+/- 5)
warning	cg/wt	440	0.25 on	1 cycle	-12 (+/- 1)
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2(f1)on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-10/ -10 (+/- 1)
call waiting	cg/cw	480	0.5 on	1 cycle	-17 (+/- 1)
caller waiting	cg/cr	425	0.4 on, 0.2 off, 4.0 on, 4.0 off (repeating)	30, followed by busy tone	-10 (+/- 5)
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for the Philippines (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
off-hook warning	xcg/roh	1400 + 2067 + 2467 (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2067 + 2467 + 2600 (VSP3 only)	0.1 on 0.1 off	infinite	-4.5/ -4.5/ -4.5 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 1dB)  -6/ -5/ -6/ -6 (VSP3 only) (+/- 1dB)
negative acknowledge	xcg/nack	425	0.2 on, 0.2 off	60	-10 (+/- 1)
vacant number	xcg/vac	480 + 620	2.5 on, 0.5 off	infinite	-13 + -13 (+/- 5)
special conditions dial tone	xcg/spec	425 (+/- 10)	0.1 on, 0.1 off	20	-12 (+/- 1)
recall dial tone	srvtn/rdt	400 + 425	0.25 on, 0.25 off	20	-13 + -13 (+/- 5)
confirmation	srvtn/conf	400	0.1 on, 0.1 off, 0.3 on, 0.3 off	single cycle	-10 (+/- 5)
held	srvtn/ht	400	0.5 on, 2.5 off	infinite	-10 (+/- 5)
message waiting	srvtn/mwt	425	0.16 on, 0.16 off	20	-6 to -10
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## Poland

### Definition of supported tones for Poland

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425 (+/- 7)	continuous	60	-6 (+/- 2)
(audible) ringing	cg/rt	425 (+/- 7)	1.0 on, 4.0 off (+/- 8%)	infinite	-3
busy	cg/bt	425 (+/- 7)	0.5 on, 0.5 off (+/- 3%)	infinite	-5
congestion	cg/ct	425 (+/- 7)	0.5 on, 0.5 off (+/- 3%)	infinite	-3
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3) (+/- 50)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/-0.07), 0.33 (f3) on (+/- 0.07), 1.0 off (+/- 0.25)	1 cycle	-3/ -3/ -3
warning	cg/wt	1400 (+/- 1.5%)	0.5 on (+/- 10%)	1 cycle	-34 (+/- 1.5 dB)
pay phone recognition	cg/prt,	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-9/ -9
call waiting	cg/cw	425 (+/- 7)	0.15 on, 0.15 traffic, 0.15 on	1 cycle	-9
caller waiting	cg/cr		cg/rt for 30 (+/- 10%), then cg/bt for remaining time	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Poland (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	1400 + 2066 + 2450 (+/-2%) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2066 + 2450 + 2600 (+/-2%) (VSP3)	0.1 on, 0.1 off	infinite	-3.5 + -3.5 + -3.5 +/- 2 dB (VSP2/ VSP3-o/ 2pVSP4e)  -5 + -5 + -5 + -5 (+/-2 dB) (VSP3)
negative acknowledge	xcg/nack	425 (+/- 15)	0.12 off, 0.12 on	60	-3 (+/- 1 dB)
vacant number	xcg/vac	Mapped to cg/ct			
special conditions dial tone	xcg/spec	350 + 425 (+/- 7)	continuous	20	-6 + -6
recall dial tone	srvtn/rdt	Mapped to cg/dt			
confirmation	srvtn/conf	425 (+/- 7)	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-3 (+/- 1 dB)
held	srvtn/ht	425 (+/- 7)	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-3 (+/- 1 dB)
message waiting	srvtn/mwt	425 (+/- 7)	(0.1 on, 0.1 off) x 10 then continuous	20	-6 (+/- 2)
(2 of 2)					

## Portugal

### Definition of supported tones for Portugal

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1 dB)
dial	cg/dt	425	continuous	20	-13
(audible) ringing	cg/rt	425	1.0 on, 5.0 off	infinite	-14
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-12
congestion	cg/ct	425	0.2 on, 0.2 off	infinite	-10
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on 1.0 off	1 cycle	-13/ -13/ - 13
warning	cg/wt	1400 (+/- 1.5%)	0.5 on	1 cycle	-34
pay phone recognition	cg/prt	1477(f1) 941(f2)	0.2(f1), 0.2 traffic, 0.2 (f2)	1 cycle	-20/ -20
call waiting	cg/cw	425	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-13
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-13

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Definitions of audible tones by country

**Definition of supported tones for Portugal (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1 dB)
off-hook warning	xcg/roh	950 + 1400 + 2600 (VSP2/ VSP3-o/ 2pVSP4e only)  950 + 1400 + 1800 + 2600 (VSP3 only)	0.1 on, 0.1 off	infinite	-18 + -18 + -18 (VSP2/ VSP3-o/ 2pVSP4e)  -19 + -19 + -19 + -19 (VSP3)
negative acknowledge	xcg/nack	950(f1) 1400(f2) 1800(f3)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on 1.0 off	60	-5/ -5/ -5
vacant number	xcg/vac	425	0.2 on, 0.2 off	infinite	-7
special conditions dial tone	xcg/spec	425	1 on, 0.2 off	20	-10
recall dial	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	425	1 on, 0.2 off	1 cycle	-13
held	srvtn/ht	450	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-8
message waiting	srvtn/mwt	425	(0.1 on, 0.1 off) x 10 then continuous	20	-13
(2 of 2)					

## Romania

### Definition of supported tones for Romania

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	450	continuous	15	-4.5
(audible) ringing	cg/rt	450	1.5 on, 3.5 off	infinite	-4.5
busy	cg/bt	450	0.168 on, 0.168 off	infinite	-4.5
congestion	cg/ct	450	0.5 on, 0.5 off	infinite	-4.5
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33(f1) on 0.33 (f2) on 0.33(f3) on 1.0 off	1 cycle	-4.5 + -4.5 + -4.5
warning	cg/wt	450	0.1 on, 0.5 traffic	3 cycles	-12
pay phone recognition	cg/prt	1100 (f1), 1750 (f2), 750 (f3), 1450 (f4)	0.1 (f1 + f2) on, 0.1 (f3 + f4) on, 0.2 traffic	3 cycles	-4.5 + -4.5 / -4.5 + -4.5
call waiting	cg/cw	450	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-12
caller waiting	cg/cr	450	1.5 on, 3.5 off	infinite	-4.5
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	3000	continuous	infinite	3
negative acknowledge	xcg/nack	450	0.5 on, 0.5 off	60	-8
vacant number	xcg/vac	450	0.362 on, 0.11 off, (0.092 on, 0.11 off) x 6	infinite	-4.5
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Romania (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
special conditions dial	xcg/spec	450 modulated by 25 at 100% depth	0.4 on, 0.04 off	20	-4.5
recall dial	srvtn/rdt	350 + 450	continuous	20	-4.5 + -4.5
confirmation	srvtn/conf	351 + 439 (+/- 2%)	0.1 on, 0.1 off, 0.3 on, 0.1 off	1 cycle	-10 + -10 (+/- 2 dB)
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	450 modulated by 25 at 100% depth	0.4 on, 0.4 off	20	-4.5
(2 of 2)					

## Russia

### Definition of supported tones for Russia

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425 (+/-3)	continuous	20	-10 (+/-1)
(audible) ringing	cg/rt	425 (+/-3)	1.0 (+/-0.1) on, 4.0 (+/-0.4) off	infinite	-10 (+/-1)
busy	cg/bt	425 (+/-3)	0.4 on 0.4 off (all +/-0.04)	infinite	-10 (+/-1)
congestion	cg/ct	425 (+/-3)	0.2 on, 0.2 off	infinite	-10 (+/-1)
special information	cg/sit	950 (f1), 1400 (f2), 1800 (f3) (all +/-5)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on (all +/-0.07)  1.0 (+/- 0.25) off repeated	infinite	-13 (f1), -13 (f2), -13 (f3)
warning	cg/wt	1420 (+/- 20)	0.4 (+/- 0.04) on, 15 (+/-3) off	infinite	-15 (+/-1)
pay phone recognition	cg/prt	1633 (f1), 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2 traffic	5 cycles	-10 (+/-1) (f1), -10 (+/-1) (f2)
call waiting	cg/cw	425 (+/-3)	0.2 (+/- 0.02) on	1 cycle	-15 (+/-1)
caller waiting	cg/cr	425 (+/-3)	0.2 (+/- 0.02) on, 5 (+/-0.5) off repeated	infinite	-10 (+/-1)

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Definitions of audible tones by country

Definition of supported tones for Russia (continued)

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	1400 (f1), +2067 (f2), +2467 (f3), +2600 (f4)  <b>Attention:</b> f3 is only supported by VSP3	0.1 on, 0.1 off	infinite	-6 (f1), -5 (f2), -6 (f3), -6 (f4) (all +/-0.2)
negative acknowledge	xcg/nack	950 (f1), 1400 (f2), 1800 (f3), (all +/-5)	0.33 on (f1), 0.33 on (f2), 0.33 on (f3), (all +/-0.07)  1.0 (+/-0.25 off repeated	infinite	-13 (f1), -13 (f2), -13 (f3)
vacant number	xcg/vac	950 (f1), 1400 (f2), 1800 (f3), (all +/-5)	0.33 on (f1), 0.33 on (f2), 0.33 on (f3) (all +/-0.07)  1.0 (+/-0.25 off repeated	infinite	-13 (f1), -13 (f2), -13 (f3)
special conditions dial tone	xcg/spec	425 (+/-3)	0.4 (+/- 0.04) on, 0.04 (+/- 0.004) off	20	-10 (+/-1)
recall dial tone	srvtn/rdt	425 (+/-3)	continuous	20	-10 (+/-1)
confirmation	srvtn/conf	425 (+/-3)	continuous	20	-10 (+/-1)
(2 of 3)					

Definitions of audible tones by country

**Definition of supported tones for Russia (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425 (+/-3)	(0.1 on, 0.1 off) repeated 10 times, continuous on (+/-10%)	20 (+/-10%)	-10 (+/-1)

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## Singapore

### Definition of supported tones for Singapore

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425	continuous	20	-15
(audible) ringing	cg/rt	425 modulated by 24 at 100% depth	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-10
busy	cg/bt	425	0.75 on, 0.75 off	infinite	-10
congestion	cg/ct	425	0.25 on, 0.25 off	infinite	-10
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, 1.0 off	1 cycle	-10/ -10/ - 10
warning	cg/wt	425	0.624 on 4.376 off (+/-5%)	1 cycle	-20
pay phone recognition	ct/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-20/ -20 (+/- 2 dB)
call waiting	cg/cw	425	0.5 on, 0.25 traffic, 1.0 on	1 cycle	-12
caller waiting	cg/cr	425 modulated by 24 at 100% depth	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for Singapore (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	3200	continuous	infinite	-8 (+/- 2 dB)
negative acknowledge	xcg/nack	425	0.25 on, 0.25 off	60	-10
vacant number	xcg/vac	425	2.5 on, 0.5 off	infinite	-10
special conditions dial tone	xcg/spec	425	0.25 on, 0.25 off, 0.25 on, 0.25 off	20	-12
recall dial tone	srvtn/rdt	425	continuous	20	-15
confirmation	srvtn/conf	425	0.06 on, 0.06 off	1 cycle	-12
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425	0.25 on, 0.25 off, 0.25 on, 0.25 off	20	-12
(2 of 2)					

## Spain

### Definition of supported tones for Spain

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 5%)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
dial	cg/dt	425	continuous	20	-6
(audible) ringing	cg/rt	425	1.5 on, 3.0 off	infinite	-6
busy	cg/bt	425	0.2 on, 0.2 off	infinite	-6
congestion	cg/ct	425	(0.2 on, 0.2 off) x 2 0.2 on, 0.6 off	infinite	-6
special information	cg/sit	950(f1)/ 1400(f2)/ 1800(f3) (+/- 50 Hz)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1 off (+/- 0.25)	1 cycle	-17/ -17/ - 17
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.018 on (+/- 20)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	1600	0.05 on	1 cycle	-20
call waiting	cg/cw	425	0.175 on, 0.175 traffic, 0.175 on	1 cycle	-6
caller waiting	cg/cr		cg/rt for 30 (+/-10%) followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	300	continuous	infinite	-6

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Definitions of audible tones by country

(continued) Definition of supported tones for Spain

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 5%)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (VSP2/ VSP3-o/ 2pVSP4e)  1404 + 2060 + 2452 + 2604 (VSP3)	continuous	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	450	0.12 on, 0.12 off	60	-8
vacant number	xcg/vac	425	0.2 on, 0.2 off, 0.2 on, 0.6 off	infinite	-6
special conditions dial tone	xcg/spec	425	1.0 on, 0.1 off	20	-6
recall dial tone	srvtn/rdt	600	continuous	20	-6
confirmation	srvtn/conf	450	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-8
held	srvtn/ht	450	3.25 off, 0.25 on, 0.25 off, 0.25 on	infinite	-8
message waiting	srvtn/mwt	425	(0.1 on, 0.1 off) x 10 then continuous	20	-6
(2 of 2)					

## Sweden

### Definition of supported tones for Sweden

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/-10%)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
dial	cg/dt	425	continuous	20	-9
(audible) ringing	cg/rt	425	1.0 on, 5.0 off	infinite	-9
busy	cg/bt	425	0.25 on, 0.25 off	infinite	-9
congestion	cg/ct	425	0.25 on, 0.75 off	infinite	-9
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50 Hz)	0.33 (f1) on (+/- 0.07), 0.33 (f2) on (+/- 0.07), 0.33 (f3) on (+/- 0.07), 1.0 off (+/- 0.25)	1 cycle	-12/ -12/ - 12
warning	cg/wt	1400 (+/- 1.5%)	0.35 on	1 cycle	-34
pay phone recognition	cg/prt	1633 (f1) 1336 (f2) (+/- 8%)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	425	0.2 on, 0.5 traffic, 0.2 on	1 cycle	-12
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-9

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Definitions of audible tones by country

**Definition of supported tones for Sweden (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/-10%)	Duration (s) (+/-10%)	Level (dBm) (+/-1 dB)
off-hook warning	xcg/roh	1404 + 2060 + 2604 (VSP2/ VSP3-o/ 2pVSP4e)  1404 + 2060 + 2452 + 2604 (VSP3)	continuous	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	mapped to cg/ct frequency and cadence		60	map to cg/ ct
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	425	0.32 on, 0.02 off	20	-9
recall dial tone	srvtn/rdt	425	continuous	20	-9
confirmation	srvtn/conf	450	0.16 off, 0.16 on, 0.16 off, 0.32 on, 0.48 off	1 cycle	-8
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425	(0.1 on, 0.1 off) x 10 then continuous	20	-9
(2 of 2)					

## Switzerland

### Definition of supported tones for Switzerland

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1.5 dB)
dial	cg/dt	425	continuous	20	-1.5
(audible) ringing	cg/rt	425	1.0 on, 4.0 off	infinite	-6.5
busy	cg/bt	425	0.5 on, 0.5 off	infinite	-6.5
congestion	cg/ct	425	0.2 on, 0.2 off	infinite	-6.5
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50)	0.33 (f1) on (+/- 0.04), 0.33 (f2) on (+/- 0.04), 0.33 (f3) on (+/- 0.04), 1.0 off (+/- 0.1)	1 cycle	-6.5/ -6.5/ -6.5
warning	cg/wt	1400 (+/- 50)	0.45 on (+/- 0.1)	1 cycle	-14 (+/- 3)
pay phone recognition	cg/prt	800(f1) 1200(f2) (+/- 1%)	0.2 (f1) on, 0.2 off, 0.2 (f2) on	1 cycle	-20/ -20
call waiting	cg/cw	425	0.2 on, 0.2 traffic, 0.2 on	1 cycle	-14 (+/- 3)
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-11 (+/- 2 dB)

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Definitions of audible tones by country

**Definition of supported tones for Switzerland (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 15)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 1.5 dB)
off-hook warning	xcg/roh	400 (f1) (+/- 50)/ 1000 (f2) (+/- 100)/ 2700 (f3) (+/- 150)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on (+/- 0.02)	infinite	3/ 3/ 3
negative acknowledge	xcg/nack	mapped to cg/ct frequency cadence and level		60	
vacant number	xcg/vac	mapped to cg/ct			
special conditions dial tone	xcg/spec	425 (f1) 340 (f2)	1.1 (f1+f2), 1.1 (f1) (+/- 0.1)	20	-4.5 + -4.5 / -1.5
recall dial tone	srvtn/rdt	mapped to cg/dt			
confirmation	srvtn/conf	425 (f1) 850 (f2) (+/- 50)	(0.2 (f1) on, 0.2 (f2) on) x 2, 1.0 off (+/- 0.25)	1 cycle	-6.5
held	srvtn/ht	1400 (+/- 50)	0.4 on, 15.0 off	infinite	-15 (+/- 2 dB)
message waiting	srvtn/mwt	425	(0.1 on, 0.1 off) x 10 then continuous	20	-1.5
(2 of 2)					

## Taiwan

### Definition of supported tones for Taiwan

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	350 + 440	continuous	16	-13 + -13
(audible) ringing	cg/rt	440 + 480	1.0 on, 2.0 off	infinite	-19 + -19
busy	cg/bt	480 + 620	0.5 on, 0.5 off	infinite	-24 + -24
congestion	cg/ct	480 + 620	0.25 on, 0.25 off	infinite	-24 + -24
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) 0.33 (f2) 0.33 (f3) 1.0 off	1 cycle	-10/ -10/ - 10
warning	cg/wt	392 (f1) 494 (f2) 587 (f3)	0.5 (f1) on, 0.5 (f2) on, 1.5 (f3) on	1 cycle	-17/ -17/ - 17
pay phone recognition	cg/prt,	1633 (f1) 1336(f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on	1 cycle	-10/ -10
call waiting	cg/cw	440 + 480	1.5 on	1 cycle	-13 + -13
call waiting alternative	cg/cw	350 + 480	0.25 on 0.25 off 0.25 on	1 cycle	-13+ -13
caller waiting	cg/cr	350 + 440	0.25 on, 0.25 off, 0.25 on, 5.25 off	infinite	-13 + - 13
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	300	continuous	infinite	-13
off-hook warning	xcg/roh	480	continuous	infinite	-3
negative acknowledge	xcg/nack	480 + 620	0.25 on, 0.25 off	60	-24 + -24
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Taiwan (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
vacant number	xcg/vac	480 + 620	0.25 on, 0.25 off	infinite	-24 + -24
special conditions dial tone	xcg/spec	350 + 440	(0.1 on, 0.1 off) x 3 then continuous	20	-13 + -13
recall dial tone	srvtn/rdt	350 + 440	continuous	16	-13 + -13
confirmation	srvtn/conf	350 + 440	0.1 on, 0.1 off, 0.3 on	1 cycle	-13 + -13
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	350 + 440	(0.1 on, 0.1 off) x 3 then continuous	20	-13 + -13

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## Thailand

### Definition of supported tones for Thailand

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	400 modulated by 50 at 100% depth	continuous	20	-10
(audible) ringing	cg/rt	400	1.0 on, 4.0 off	infinite	-10
busy	cg/bt	400	0.5 on, 0.5 off	infinite	-10
congestion	cg/ct	400	0.5 on, 0.5 off	infinite	-10
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, 0.99 off	infinite	-13/ -13/ - 13
warning	cg/wt	1400	0.5 on	1 cycle	-10
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2), 2.0 traffic	5 cycles	-10/ -10 (+/- 1)
call waiting	cg/cw	400	0.5 on, 0.25 traffic, 1.0 on	1 cycle	-12 (+/- 3)
caller waiting	cg/cr	400	1.0 on, 4.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal completed immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	400	0.3 on, 0.3 off	infinite	-10
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Thailand (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
negative acknowledge	xcg/nack	400	0.5 on, 0.5 off	60	-10
vacant number	xcg/vac	400	0.1 on, 0.1 off 0.1 on, 0.1 off, 0.1 on, 0.1 off, 0.3 on, 0.1 off	infinite	-9
special conditions dial tone	xcg/spec	400	0.25 on, 0.25 off, 0.25 on, 0.25 off	20	-12 (+/- 3)
recall dial tone	srvtn/rdt	400 modulated by 50 at 100% depth	continuous	20	-10
confirmation	srvtn/conf	400	0.06 on, 0.06 off	1 cycle	-12
held	srvtn/ht	silence		infinite	
message waiting	srvtn/mwt	400	0.25 on, 0.25 off, 0.25 on, 0.25 off	20	-12 (+/- 3)
(2 of 2)					

## Turkey

### Definition of supported tones for Turkey

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 5%)	Cadence (s)	Duration (s)	Level (dBm) (+/- 0.4)
dial	cg/dt	450	continuous	20	-10
(audible) ringing	cg/rt	450	2.0 on, 4.0 off	infinite	-10
busy	cg/bt	450	0.5 on, 0.5 off	infinite	-10
congestion	cg/ct	450	(0.2 on, 0.2 off) x 3 0.6 on, 0.2 off	infinite	-10
special information	cg/sit	950 (f1) 1400 (f2) 1800 (f3)	0.3 (f1) 0.3 (f2) 0.3 (f3) 1.0 off	1 cycle	-10
warning	cg/wt	450	0.2 on, 0.2 off	1 cycle	-12
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 off, 0.2 (f2) on	1 cycle	-10
call waiting	cg/cw	450	0.2 on, 0.6 off, 0.2 on	1 cycle	-12
caller waiting	cg/cr	450	2.0 on, 4.0 off	repeating	-10
pay	bcb/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 2)					

Definitions of audible tones by country

**Definition of supported tones for Turkey (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 5%)	Cadence (s)	Duration (s)	Level (dBm) (+/- 0.4)
off-hook warning	xcg/roh	1400 + 2060 + 2600 (VSP2/ VSP3-o/ 2pVSP4e only)  1400 + 2060 + 2450 + 2600 (VSP3)	0.1 on, 0.1 off	infinite	-6 (VSP2/ VSP3-o/ 2pVSP4e)  -6 (VSP3)
negative acknowledge	xcg/nack	950 (f1) 1400 (f2) 1800 (f3)	0.3 (f1) 0.3 (f2) 0.3 (f3) 1.0 off	1 cycle	-10
vacant number	xcg/vac	450	0.2 on, 0.2 off	infinite	-10
special conditions dial tone	xcg/spec	450	1.0 on, 0.25 off	infinite	-10
recall dial tone	srvtn/rdt	450		infinite	-10
confirmation	srvtn/conf	450	0.04 on	1 cycle	-10
held	srvtn/ht	350 (f1) 450 (f2)	0.5 (f1) on, 0.5 off, 0.5 (f2) on, 2.5 off	infinite	12 + -12 / -12
message waiting	srvtn/mwt	450	0.2 on, 0.2 off, 0.2 on, 0.6 off	infinite	-12
(2 of 2)					

## United Kingdom

### Definition of supported tones for the United Kingdom

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
dial	cg/dt	350 + 440	continuous	20	-10 + -10
(audible) ringing	cg/rt	400 + 450	0.4 on, 0.2 off, 0.4 on, 2.0 off	infinite	-16 + -16
busy	cg/bt	400	0.375 on, 0.375 off	infinite	-13
congestion	cg/ct	400 (f1) 400 (f2)	0.4 (f1) on, 0.35 off, 0.225 (f2) on, 0.525 off	infinite	-19/ -13
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50 Hz)	0.33 (f1), 0.33 (f2), 0.33 (f3), 1.0 off	1 cycle	-10/ -10/ - 10
toneburst on answer (replaces warning tone)	cg/wt	1111 (+/- 5%)	0.18 on (+/- 20)	once then signal complete	-13 (+/- 2)
pay phone recognition	cg/prt	400	0.125 on	1 cycle	-13
call waiting	cg/cw	400	2.5 on	1 cycle	-13
caller waiting	cg/cr		cg/rt for 30 followed by cg/bt for remainder	infinite	
pay	xcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			

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Definitions of audible tones by country

**Definition of supported tones for the United Kingdom (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 2%)	Cadence (s) (+/- 10%)	Duration (s) (+/- 10%)	Level (dBm) (+/- 2 dB)
off-hook warning	xcg/roh	1400 + 2066 + 2600 (+/-2%) (VSP2/ VSP3-o/ 2pVSP4e)  1400 + 2066 + 2450 + 2600 (+/-2%) (VSP3)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (VSP2/ VSP3-o/ 2pVSP4e)  -6 + -6 + -6 + -6 (VSP3)
negative acknowledge	xcg/nack	mapped to xcg/vac frequency, cadence and level		60	
vacant number	xcg/vac	400	continuous	infinite	-13
special conditions dial tone	xcg/spec	350 (f1) + 440 (f2)	0.75 on, 0.75 off (f1), continuous(f 2)	20	-10 (f1) + - 10 (f2)
recall dial tone	srvtn/rdt		map to cg/dt	20	
confirmation	srvtn/conf	351 + 439	0.1 on, 0.1 off, 0.3 on, 0.1 off	1 cycle	-10 + -10
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	350 + 440	(0.1 on, 0.1 off) x 10 then continuous	infinite	-10 + -10
(2 of 2)					

## United States

### Definition of supported tones for the United States

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s)	Level (dBm) (+/-1.5 dBm)
dial	cg/dt	350 + 440 (+/- 0.5%)	continuous	20 (+/- 10%)	-13 + -13 (+/- 1.5 dB)
(audible) ringing	cg/rt	440 + 480 (+/- 0.5%)	2.0 on, 4.0 off (+/- 10%)	infinite	-19 + -19 (+/- 1.5 dB)
busy	cg/bt	480 + 620 (+/- 0.5%)	0.5 on, 0.5 off (+/- 10%)	infinite	-24 + -24 (+/- 1.5 dB)
congestion	cg/ct	480 + 620 (+/- 0.5%)	0.25 on, 0.25 off (+/- 10%)	infinite	-24 + -24 (+/- 1.5 dB)
special information	cg/sit	950(f1) 1400(f2) 1800(f3) (+/- 50 Hz)	0.33 (f1) on 0.33 (f2) on 0.33 (f3) on 1.0 off (+/- 10%)	1 cycle	-24/-24/- 24 (+/- 1.5 dB)
warning	cg/wt	1400 (+/- 1.5%)	0.5 on (+/- 10%)	1 cycle	-7 (+/- 1.5 dB)
pay phone recognition	cg/prt	1100 (f1) 750 (f2)	(0.2 (f1) on 0.2 (f1) off, 0.2 (f2) on 2.0 traffic) x 5	13	-6 (f1) -7 (f2)
call waiting	cg/cw	440 (+/- 0.5%)	0.3 on (+/- 10%)	1 cycle	-13 (+/- 1.5dB)
caller waiting	cg/cr	440 + 480 (f1) 440 (f2)	2.0 (f1) 0.3 (f2) 3.7 off (repeating)	infinite	f1 = -19 + -19 f2 = -13
pay	xcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
(1 of 3)					

Definitions of audible tones by country

**Definition of supported tones for the United States (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s)	Level (dBm) (+/-1.5 dBm)
off-hook warning	xcg/roh	1400 + 2060 + 2600 (VSP2/ VSP3-o/ 2pVSP4e) (+/- 2%)  1400 + 2060 + 2450 + 2600 (VSP3) (+/- 2%)	0.1 on, 0.1 off	infinite	-5 + -5 + -5 (+/- 1.5dB) (VSP2)  -6 + -6 + -6 + -6 (+/- 1.5dB) (VSP3/ VSP3-o/ 2pVSP4e)
negative acknowledge	xcg/nack	480 + 620	0.25 on, 0.25 off (repeating)	infinite	-24 + -24
vacant number	xcg/vac	map to cg/ct		infinite	
special conditions dial tone	xcg/spec	map to cg/dt			
recall dial tone	srvtn/rdt	350 + 440 (+/- 0.5%)	(0.1 on, 0.1 off) x 3, then continuous (+/- 10%)	20 (+/- 10%)	-13 + -13 (+/- 1.5dB)
confirmation	srvtn/conf	350 + 440 (+/- 0.5%)	0.1 on, 0.1 off (+/- 10%)	3 cycles	-13 + -13 (+/- 1.5dB)
held	srvtn/ht	620	0.25 on, 0.25 off, 0.25 on, 3.25 off (repeating)	infinite	-24
(2 of 3)					

Definitions of audible tones by country

**Definition of supported tones for the United States (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz) (+/- 0.5%)	Cadence (s) (+/- 10%)	Duration (s)	Level (dBm) (+/-1.5 dBm)
message waiting	srvtn/mwt	350 + 440 (+/- 0.5%)	(0.1 on, 0.1 off) x 10, then continuous (+/- 10%)	20 (+/-10%)	-13 + -13 (+/- 1.5dB)
carrier dial	carr/cdt	400 (+/- 0.5%)	continuous	20 (+/- 10%)	-10 (+/- 1.5 dB)
carrier answer	carr/ans	silence (no frequency), signal complete immediate			
carrier charging	carr/chg	silence (no frequency), signal complete immediate			
long distance indicator	carr/ldi	silence (no frequency), signal complete immediate			
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## Venezuela

### Definition of supported tones for Venezuela

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
dial	cg/dt	425 (+/-10)	continuous	20	-10
(audible) ringing	cg/rt	425 (+/- 10)	1.0 on, 4.0 off	infinite	-10
busy	cg/bt	425 (+/- 10)	0.5 on, 0.5 off	infinite	-10
congestion	cg/ct	425 (+/- 10)	0.25 on, 0.25 off	repeating	-10
special information	cg/sit	950 (f1) 1440 (f2) 1800 (f3) (+/- 50)	0.33 (f1) on, 0.33 (f2) on, 0.33 (f3) on, (+/- .07) 1.0 off (+/- 0.25)	single cycle	-10
warning	cg/wt	800	1.0 (+/- 0.1)	single cycle	-18.5
pay phone recognition	cg/prt	1633 (f1) 1336 (f2)	0.2 (f1) on, 0.2 traffic, 0.2 (f2) on, 2.0 traffic	5 cycles	-10
call waiting	cg/cw	425	0.3 on 1.0 off	1 cycle	-10
caller waiting	cg/cr	425 (+/- 10)	1.0 on, 4.0 off	infinite	-10
pay	bcg/bpy	silence (no frequency), signal complete immediate			
comfort	xcg/cmft	silence (no frequency), signal complete immediate			
off-hook warning	xcg/roh	1440(f1) 2060(f2) 2450(f3) 2600(f4)	0.1 on, 0.1 off	repeating	-6
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Definitions of audible tones by country

**Definition of supported tones for Venezuela (continued)**

Tone name	Package/ identifier	Characteristics			
		Frequency (Hz)	Cadence (s)	Duration (s)	Level (dBm)
negative acknowledge	xcg/nack	425	0.25 on, 0.25 off	repeating	-13
vacant number	xcg/vac	425	0.25 on, 0.25 off	repeating	-10
special conditions dial	xcg/spec	425	(0.1 on, 0.1 off) x 3, 19.4 on	steady on	-10
recall dial tone	srvtn/rdt	425 (+/- 10)	continuous	continuous	-10
confirmation	srvtn/conf	425 (+/- 10)	0.1 on, 0.1 off, 0.3 on, 0.1 off	single cycle	-10
held	srvtn/ht	silence (no frequency), signal complete immediate			
message waiting	srvtn/mwt	425	0.1 on, 0.1 off	repeating	-10

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**Technology Fundamentals**

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