

Application Note - Interoperability

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I. Introduction.

The purpose of this document is to provide information to customers of Quintum Technologies who may be interested in testing or having a Quintum product interoperate with other vendors that support H.323. The information contained within this document provides general guidelines for interoperability. Since every application is different as well as the equipment setup that a customer may use, it is not possible to provide complete and specific information. Hopefully, this document will provide the necessary information to address most situations.

QTAC personnel are not able to configure, service or support any other vendor's equipment directly for any reason.

For additional support, please contact the QTAC at the above numbers or email address.

II. Equipment Information.

While Quintum continually tests against as many other vendor products as possible, your particular product may not be listed here. This does not mean that the Quintum product(s) will not interoperate with your equipment, only that we have not tested with your equipment. In many cases, our customers may have already tested with other vendors and have not provided us that information. Quintum will be happy to assist with any testing that you require in this aspect, on a scheduled basis.

A. Quintum Products;

This document covers the following Quintum Products and software;

- Tenor Analog product series (A400 & A800)
- Tenor Digital product series (D800, D1600, D2400, D3000)
- Tenor software version P3-1-10 and higher

B. Other Equipment Manufacturer (OEM) Products;

This document covers the following OEM products and software;

- Cisco 1750 – IOS version 12.1
- Cisco AS5300 – IOS version 12.1
- Cisco Call Manager
- Clarent
- Microsoft NetMeeting

III. Considerations.

Whenever you wish to test the Quintum product(s) with another VoIP vendor, you will need to gather the following information;

A. Vendor make/model and software version.

B. Will the Tenor connect to a gateway or through a gatekeeper?

1. Tenor only operates to a Clarent Gatekeeper and not directly to the Clarent GW.
2. If the Cisco is a gatekeeper, does the Tenor need to register to the Cisco's gatekeeper or can this be done on a gateway-to-gateway level?
3. If the Tenor needs to register to the Cisco's gatekeeper, will the Cisco be utilizing technology prefixes? If so what are the Cisco's technology prefix and what are the technology prefix(es) that the Cisco will send to the Tenor?
4. Not an issue with NetMeeting as NetMeeting is an endpoint.

C. Does the Vendor require an H323 ID from the Tenor? If so, what is the ID that the vendor needs to see from the Tenor?

D. What is the audio compression that the vendor is using?

1. The Tenor currently does not support auto-negotiation of audio compression and must be manually configured for a specific audio compression rate.

- E. Dial patterns and numbers to be sent to the vendor from the Tenor and from the vendor to the Tenor.
 - 1. This is extremely crucial. The Tenor is designed to comply with E.164 and ISO/IEC 11571 Numbering plans as provided for in Appendix V of the H.323 specification. In testing with other vendors, Quintum has found many cases where the other vendor does not comply with this specification (Cisco being one vendor) and specific configuration on the Tenor is required to remedy this. More information on this is provided in Appendix A of this document.
- F. Tenor PacketSaver must be disabled. The Tenor PacketSaver feature is a proprietary feature and is not interoperable with any other vendor. It must be disabled when performing interoperability with other H.323 vendors.
- G. Fax Interoperability. At current time, Tenor does not interoperate with other H.323 vendors for fax calls.
- H. If using Cisco, please make sure that the Cisco Dial Peer has its DTMF relay set to H245 alphanumeric;


```
dtmf-relay [cisco-rtp] [h245-signal] [h245-alphanumeric]
```
- I. Also, the Tenor does not currently support the Cisco audio codec of G729R8, please use G729BR8 which is a much more robust audio algorithm

IV. Tenor Call Routing Basics and other considerations.

In order to be able to diagnose and prepare the Tenor and your equipment for testing interoperating, it is important to understand how the Tenor routes calls using the number. This section only provides a brief overview. For more details, please view the Tenor Call Routing document on our web side under the Misc Documents page.

A. E.164 vs. Private.

When configured normally, the Tenor will route all public calls based on the E.164 format (this is part of the H.323 specification). The E.164 format specifies that a public number going over IP must be in the following format - country code + city area code (optional) + local number. The E.164 format does not allow for international prefix, long distance prefix or any other prefixes to be sent over IP nor used for routing matches. This concept is very important to understand as many other vendors disregard this standard and route based on any digits for a public call and this is not part of the specification. For more information on the E.164 format, please refer to section IX of this document.

For a private number, the Tenor will route based on the digits received.

B. Calls coming in to Tenor from IP.

When the Tenor receives a call in from IP, it will look at the Q931 message that is sent in from the origination gateway. There are 3 main items, within the Q931 message that the Tenor looks at in terms of routing. These are the NPI or Numbering Plan Id, the TOA/TON or Type of Address/Type of Number and the dialed digits. A typical Q931 setup message for an incoming IP call is shown below in figure 1.

```

Message Type: SETUP <0x5>
H323Q931: 53235778: Bearer Capability:
H323Q931: 53235778: IE Len: 3
H323Q931: 53235778: Coding Standard: 0x0
H323Q931: 53235778: Info Transfer Cap: 0x0
H323Q931: 53235778: Transfer Mode: 0x2
H323Q931: 53235778: Info Transfer Rate: 0x0
H323Q931: 53235778: Layer 1 protocol: 0x2
H323Q931: 53235778: Display IE:
H323Q931: 53235778: IE Len: 13
H323Q931: 53235778: Called Party IE:
H323Q931: 53235778: IE Len: 12
H323Q931: 53235778: Number Type: 0x1 → TON/TOA
H323Q931: 53235778: Numbering Plan: 0x1 → NPI
H323Q931: 53235778: Digits: 19995551000 → incoming digits
  
```

Figure 1

In figure 1, above, you can see that the incoming number is 19995551000. These are the digits that the origination gateway sent to the Tenor. The NPI or Numbering Plan Id is set to 1 which indicates a

ISDN/Public call and the Number Type or TOA/TON is set to 1 which is international. With this setting, the Tenor is told that the number I have sent you is a public number in full international format including the country code +city/area code (if valid) + local number. The Tenor does not need to do anything further as the call is in a valid E.164 format. The Tenor will look for a match based on this number.

The other codes for NPI and TOA are shown in Table 1 below.

Numbering Plan (NPI)	Definition	Number Type (TOA/TON)	Definition
0	Unknown	0	Unknown
1	ISDN (Public/E.164)	1	International
9	Private	2	National
		4	Local

Table 1

When a call comes in to the Tenor it will look at these values and decide what to do with the number. For example, let's say that a Tenor has a country code of 1, area code of 732 and a public hunt ldn of 5551000. Below is a chart that shows the possible combinations and what the Tenor will do in each instance.

Digits rcd	NPI	TOA/TON	Tenor adds digits	Looks for match based on
17325551000	1	1		17325551000
7325551000	1	2	1	17325551000
5551000	1	4	1732	17325551000

Table 2

Table 2 shows all of the normal combinations that we would expect to see for incoming calls and as you can see, in each case above, the number that the Tenor looks for a match based on is the same (17325551000). This is how it conforms to the E.164 format.

The trouble most customers run into is when their VoIP equipment does not follow this specification. In table 3, you will see some of the problems that have been encountered in the past.

Digits rcd	NPI	TOA/TON	Tenor adds digits	Looks for match based on
17325551000	1	2	1	117325551000
17325551000	1	4	1732	173217325551000
7325551000	1	4	1732	17327325551000
17325551000	0	0	1732	173217325551000
7325551000	0	0	1732	17327325551000

Table 3

So you can see that if the originating gateway does not send the number in the correct format, the Tenor can interpret the digits incorrectly. There are several ways around this. The easiest is now available in release P3-1-10 of Tenor software. In this release, when the country is not USA, then you can delete the countrycode and the areacode (as well as the intlprefix, ldprefix, etc). When you delete these values, the Tenor will not have anything to add on to the front of the number regardless of how the origination gateway sends the call in. Just remember that the Tenor will not have these numbers to match on for any of your network so if you have other Tenors that were sending or receiving calls from this gateway, you may need to change this.

C. Calls going from Tenor (PBX) to IP.

When the Tenor receives a call from the PBX trunk group, it looks at the digits dialed and whether the call was private. Keeping to the public calls only for this document (again, download the Tenor Call Routing document from our website for more detailed information), if the first digit(s) match the intlprefix, then the Tenor will delete the prefix and route the call based on the numbers received, it believes the call is already in the E.164 format because it received the international prefix and the country code, etc., must be there for the PSTN to route it correctly.

To further show this, let's say that in addition to the above parameters for the last example, this Tenor has an international prefix (intlprefix) of 011 and a long distance prefix (ldpref) of 1. Table 4 shows the way that calls will be handled based on what is dialed.

Number dialed	Tenor deletes	Tenor adds	Looks for match on
0114416112345678	011 (intlprefix)		4416112345678
12125551212	1 (ldprefix)	1	12125551212
5551000		1732	17325551000

Table 4

The same basic thing will also happen for calls that come in from the PSTN trunk group when passthrough is set to No. There may be some slight variations of this depending upon the signaling type of the line/trunk.

D. Other Considerations.

In software version P3-1-10, there are some new features for interoperability. The first was explained earlier where you can delete the country code, area code, intlprefix and ld prefix when the country is not USA. This will stop the Tenor from adding digits on to incoming calls from IP or PBX/PSTN. Instead of routing based on the E.164 format, the Tenor will route based on the digits that it receives. You will need to make sure that you address the routing tables (ldn, lam, etc) correctly if switching to this type of dial plan.

There have been some further additions in the H323 prompt. They are;

H323id – This can be used to set the H323 id value for this gateway. Many times when you want the Tenor to register to another gatekeeper that is not a Tenor, you will need to assign a unique H323 Id to each Tenor that registers. This is how the Gatekeeper may keep track of the different gateways and allows access using the id as an authorization code.

Registerdn – This is used to say whether you want to register the phone numbers configured in this Tenor to the Gatekeeper. Some Gatekeepers do not want to know your phone numbers as they are manually configured to the Gatekeepers routing table. In this case, you would need to set this parameter to No (0).

ignorebandwidth – This command is used when the gatekeeper that this Tenor is registered to sends a request for incoming call with an invalid bandwidth specified.

defaultH245 – This command is used to determine if we will use H245 Tunneling unless specifically told not to by the remote H.323 device. We have seen problems with this as Netmeeting, does not support H245 tunneling, but does not tell us that it does not support this and we assume it does. Turning this off means that we will assume the other end does not support this feature.

h323interopflag – Right now there is only 1 flag, but this command will have many different flags for interoperability as time goes on. The current flag is used when the Tenor is registering to a Cisco Gatekeeper. At current time, by default, the Tenor will register to a Gatekeeper as a H323 gateway. If the Gatekeeper is a Cisco, there is a problem with this type of registration (even though it is a valid registration method) and Cisco will not be able to accept nor route calls to us. To get this to work correctly, we need to register to the Cisco as a voice gateway instead.

V. Additional Digit Manipulation.

In many cases, we have seen when we send calls to a Cisco, it is a requirement to add specific digits to the front of every call. Cisco uses this prefix to authorize the user and to create the billing record. As mentioned earlier, this is not part of the H.323 spec (calling for E.164 format), but the Tenor can do this in a small fashion.

Under the iptg configuration you will see parameters to add and delete digits on incoming and on outgoing calls. When you configure anything here, the manipulation that takes place is a system wide, every call, type of manipulation. What this means is that if you configure an outpref of 12345 (add 12345 to the front of outgoing calls), then every call that goes over IP from this Tenor will have 12345 added to the front of the dialed number. Currently there is no way to change this on a call-by-call basis (or based on the dialed number).

If you configure the outdel and/or outpref in this area, then the routing changes as well. When the Tenor goes to perform this function of add/deleting digits, it is changing the number that was dialed. The Tenor will change the NPI for this call to private and you will need to make sure that you have a static route configured for this private number. You will still need to have a public number route for this call in addition to the private. At the destination end, the number will still come in as public, but with the additional digits.

For example, if I want to add 1234 to all of my outgoing IP calls so that when I dial 17325551000, what will be sent will be 123417325551000, and if I am using static routes to the Cisco or other H323 device, I will need the routes to look like the following;

Static Route #1

```
CallSignalAddress = 208.226.140.87:1720
1:1732* Public LDN priority(2)
2:1* Private LDN priority(2)
```

The first entry will allow a match to the 17325551000 before the Tenor adds any digits. Then when the Tenor adds 1234 to the number, it changes the number to private, so there must be a match for this as well.

If you are not using static routes, but using a gatekeeper, then the Gatekeeper needs to accept the private number ARQ from the Tenor.

VI. Configuration Examples.

What follows are sample configurations based on applications that we have seen with our customers. It is not possible to provide information on every possible application that you might come across, but with this information, you should be able to see how the basics are done and possibly be able to expand upon this. As always, if you need additional assistance, please contact the QTAC.

Only those parameters that are specific to interoperability will be shown.

A. Tenor Gateway to Cisco Gateway.

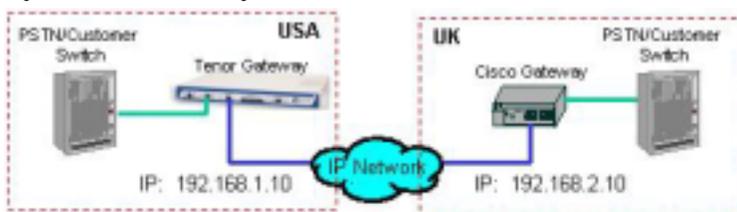


Figure 2

As shown in figure 2 above, there will be 2 sites. The first site is in the USA and has a Tenor connected to the local PSTN or to a customer owned switch, along with the IP connection. The second site, in the UK, has a Cisco Gateway that is also connected to the local PSTN or the customer owned switched as well as the IP network.

The Cisco will be using G.729br8 codec which is the ITU standard G.729 codec that Tenor supports.

Calls will flow in both directions. From the USA, calls to the UK (44) will be made over IP. The Cisco requires that 011 be in front of the digits that the Tenor sends to it. In this example, the PSTN/switch will send the 011 as part of the number. From the UK, the Cisco will send US calls to the Tenor. All calls will begin with 001, but the Tenor will need to send only 1* to the PSTN/switch.

Configuration:

Prompt	Settings	Comments
config sys#	country 1	Sets the country to anything other than US.
	countrycodec <null>	Deletes the country code.
	areacode <null>	Deletes the area code.
	intlpref 1 <null>	Deletes the international prefix.
	ldpref <null>	Deletes the long distance prefix
	mindn 7	Sets the minimum number of digits to 7.
	maxdn 16	Sets the maximum number of digits to 16
config pstntg 1#	lmpat 1 001	Sets the first lamppattern to 001.
	lamrep 1 1	Sets the first lamreplacement to 1.
config gksys#	border 0 192.168.1.10	Sets the border element to this Tenor.
config dsp#	voice 68	Sets the voice compression to G.729.
	pktsaver 0	Disables PacketSaver.
config be srout 1#	callsig 192.168.2.10	Enter the IP address of the Cisco Gateway to route calls to.
	dn 1 011* 0 0 2	Sets a directory number of 011* that is public, LDN and a priority of 2. This will be the number patter that will be routed to the Cisco.

Call Flow;

Call originates in US and terminates in UK.

PSTN/Switch sends call to Tenor (0114416112345678). Tenor receives call, does not perform and digit manipulation and looks for match on digits received. Finds a match on the static route (011*) and routes call over IP to Cisco.

This is based on the fact that the PSTN/switch will provide the Tenor with the 011 in front of the number, however, there may be times when this is not possible. If the switch can not provide the 011 and will only send 4416112345678 to the Tenor then you will need to make the following changes;

Prompt	Settings	Comments
config be srout 1#	callsig 192.168.2.10	Enter the IP address of the Cisco Gateway to route calls to.
	dn 1 011* 1 0 2	Sets a directory number of 011* that is private, LDN and a priority of 2. This will be the number patter that will be routed to the Cisco.
config iptg#	outpref 011	

In this case, the call flow will be; US PSTN/Switch sends call to Tenor (4416112345678). Tenor receives call and adds 011 to front of number (0114416112345678) and this number is now changed to a private number. Tenor looks for a match to number and finds one in the srout (011* private). Tenor routes call to destination IP as configured in callsig for srout.

Call originates from UK (Cisco) to Tenor in US.

Cisco sends call to Tenor as 0012125551000. Tenor receives call and looks for a match on these digits. Tenor finds match in lampat 1 (001). Tenor deletes matching digits off (001) and is left with 2125551000. Tenor then adds lamrep off 1 on to front of number and sends number (12125551000) to PSTN/switch.

B. Tenor Gateway to Cisco Gatekeeper to Cisco Gateway.

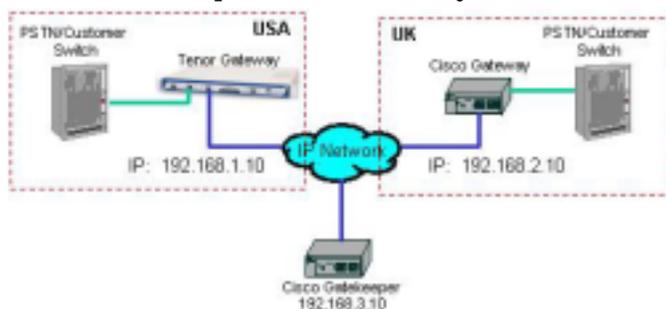


Figure 3

As shown in figure 3, the setup is similar to part A, but now, the Tenor will be registering to a Cisco Gatekeeper who will control the call routing. The Cisco GK requires the Tenor to register with a H323id of tenorus. The configuration for the Tenor will be;

Prompt	Settings	Comments
config sys#	country 1	Sets the country to anything other than US.
	countrycodec <null>	Deletes the country code.
	areacode <null>	Deletes the area code.
	intlpref 1 <null>	Deletes the international prefix.
	ldpref <null>	Deletes the long distance prefix
	mindn 7	Sets the minimum number of digits to 7.
	maxdn 16	Sets the maximum number of digits to 16
config pstntg 1#	lampat 1 001	Sets the first lampattern to 001.
	lamrep 1 1	Sets the first lamreplacement to 1.
config gksys#	border 0 0.0.0.0	Sets the border element to this Tenor.
config dsp#	voice 68	Sets the voice compression to G.729.
	pktsaver 0	Disables PacketSaver.
config h323#	primarygk 192.168.3.10	Sets the Tenor to register to the Cisco as a Gatekeeper.
	primaryauto 0	Disables the gatekeeper discovery.
	h323id tenorus	Sets the H323 Id to tenorus
	interop 0 1	Tells the Tenor to register to the Gatekeeper as a Voice gateway instead of an H323 gateway.
config be srout 1#		Should be no static routes set. The Gatekeeper will handle the routing.

Call Flow;

Call originates in US and terminates in UK.

PSTN/Switch sends call to Tenor (0114416112345678). Tenor receives call, does not perform and digit manipulation and sends a request (ARQ) to the Cisco GK for a route for 0114416112345678. The GK looks up for a match in its table, finds one and sends the destination IP (192.168.2.10) to the Tenor and the Tenor routes the call over IP to the Cisco Gateway at 192.168.2.10.

This is based on the fact that the PSTN/switch will provide the Tenor with the 011 in front of the number, however, there may be times when this is not possible. If the switch cannot provide the 011 and will only send 4416112345678 to the Tenor then you will need to make the following changes;

Prompt	Settings	Comments
config iptg#	outpref 011	

In this case, the call flow will be; US PSTN/Switch sends call to Tenor (4416112345678). Tenor receives call and adds 011 to front of number (0114416112345678) and this number is now changed to a private number. Tenor sends a request to GK for a route for 0114416112345678 (private). The Cisco looks in its table to find a match and sends the destination IP back to Tenor. Tenor routes call to destination Cisco. Call originates from UK (Cisco) to Tenor in US.

Cisco sends call to Tenor as 0012125551000. Tenor receives call and looks for a match on these digits. Tenor finds match in lampat 1 (001). Tenor deletes matching digits off (001) and is left with 2125551000. Tenor then adds lamrep off 1 on to front of number and sends number (12125551000) to PSTN/switch.

C. Tenor Setup for Clarent.

Along with the same type of information shown in Section A with Cisco, since the Tenor only interoperates with the Clarent Gatekeeper and not the Gateway, the following items will need to be configured.

1. config h323gw#
 - primary gk = <set to Clarent GK>
 - primary auto disc = 1
 - h323-id = <set to what is assigned by Clarent>
 - register dn = No
 - ignore bandwidth in acf = Yes
2. config gksys#
 - borderelement Primary = 0.0.0.0
3. config dsp#
 - audio = <set compression to what is used by Clarent>
 - PacketSaver = No
4. Same cautions as Cisco on numbers sent/received over IP.

D. Tenor setup with NetMeeting.

There are 2 main ways to configure NetMeeting to work with the Tenor. Both are explained below.

Tenor as a Gateway for Netmeeting.

When setting up NetMeeting to use the Tenor as a Gateway only, you restrict NetMeeting to using only the configured Tenor as a gateway. NetMeeting will not have access to your entire VoIP network in this configuration. While this may seem restrictive, it is the easiest way to set NetMeeting up. To configure NetMeeting in this environment, follow the steps below;

1. Start NetMeeting on your PC.
2. Click on **Tools→Options** from the NetMeeting menu bar.
3. Click on the **General** tab.
4. Click on **Advanced Calling** button.
5. Click on the check box for *Use a gateway to call telephones and videoconferencing systems* to enable this feature. If this feature is greyed out, then make sure that *Use a gatekeeper to place calls* is un-checked.

6. In the *Gateway* field, enter the IP address of the Tenor that will act as the Gateway for this NetMeeting client and click OK.
7. Click on the **Audio** tab now.
8. Click on the **Advanced** button to get to the Advanced compression settings.
9. Check the *Manually configure compression settings* option and choose **Micorosft G.723.1, 8khz, Mono, 6400 Bit/s** option from the drop down list.
10. Click on **OK** and then **OK** again.

On the Tenor, make sure that PacketSaver is disabled, the audio compression is set to G.723.1 @ 6.3kbps (both from the config dsp# prompt) and the default H245 tunneling (config h323# prompt) is set to No. Also, if you want to send calls from the Tenor to NetMeeting, follow the directions below;

1. From the Tenor's CLI go to the *config be#* prompt.
2. Type **print** to display any static routes (sroutes) currently configured.
3. If there are none, then type **sroute 1**. If there are routes, then type **sroute x**. Where the **x** is, enter the next available sroute index number.
4. At the *config be sroute x#* prompt, type **callsig nmipaddress**. Where **nmipaddress** enter the IP address of the NetMeeting client.
5. At the *config be sroute x#* prompt type **dn 1 number, 0/1, 0, 2**. This is how you assign a phone number to route to the NetMeeting client. The parameters are;
 - a) **number** – the phone number, in international format for a public number, that will be routed to the NetMeeting client.
 - b) **0/1** – 0 is for a public number, 1 is for a private type of number.
 - c) **0** – is that the number is a local directory type of number.
 - d) **2** – is a priority of 2.

Once all the above has been configured along with the Tenors other parameters, you should be able to call between the NetMeeting Client and the Tenor gateway specified.

Tenor as a Gatekeeper for Netmeeting.

When configuring NetMeeting to use the Tenor as a gatekeeper, it is important to make sure that the Tenor is running its gatekeeper process and is assigned as a gatekeeper. This is done at the config h323gw# where primary and secondary gk = 0.0.0.0. to set up NetMeeting for this, follow the directions below;

6. Start NetMeeting on your PC.
7. Click on **Tools→Options** from the NetMeeting menu bar.
8. Click on the **General** tab.
9. Click on **Advanced Calling** button.
10. Click on the check box for *Use a gatekeeper to place calls* to enable this feature.
11. In the *Gatekeeper* field, enter the IP address of the Tenor that will act as the Gatekeeper for this NetMeeting client.
12. Make sure that *Log on using my account name* check box is unchecked.
13. Check the *Log on using my phone number* check box and enter a phone number (in international format for public numbers) and click **OK**. You can use a dummy number for this, but the Tenor will need to see a phone number so that it can route calls to the NetMeeting.
14. Click on the **Audio** tab now.
15. Click on the **Advanced** button to get to the Advanced compression settings.
16. Check the *Manually configure compression settings* option and choose **Micorosft G.723.1, 8khz, Mono, 6400 Bit/s** option from the drop down list.
17. Click on **OK** and then **OK** again.

On the Tenor, make sure that PacketSaver is disabled, the audio compression is set to G.723.1 @ 6.3kbps (both from the config dsp# prompt) and the default H245 tunneling (config h323# prompt) is set to No. There is no need to configure any static routes in this scenario.

VII. Testing and Troubleshooting.

During the testing, you will need to utilize the Tenor's built in event logs to verify the dial patterns/numbers that are going through. To setup the event log for viewing this information, follow the directions below;

1. From Quintum> prompt type **ev 0 <enter>**. This will turn off any previously enabled events.
2. Type **ev +ch <enter>**. This will turn on call handler event logging.
3. Type **ev l3 <enter>**. This will set the detail level to the most information.
4. Type **ev c <enter>**. This will clear the event log buffer.
5. Type **q <enter>**. This will quit out of command mode and go into display mode.

All call information will now be displayed on your PC in real time. Try testing in one direction first, say from Cisco to Tenor, and watch the events. When the call is completed, if it failed, you can hit enter on your screen and scroll back to look at the information. What you are looking for is a message like the following;

```
CH :195077038:Routing requested for: public(1) orig=5551000 public(1) normalized=17325551000 route code = .
```

The above message tells you a number of things. The first is that there was a request to route a call. The next is that the number sent to the Tenor (original number) is orig=5551000. These are the digits that the Cisco sent to the Tenor. The final piece is that the Tenor normalized the number to 17325551000. The normalizing process is what the Tenor does to any number that is sent to it when it does not meet the E.164 standard (see appendix A). In this case, the Cisco sent 7 digits (5551000) to the Tenor. This is not in full E.164 format (country code + area code + local number), so the Tenor adds its configured country code and area code (1+732) to the front of the number and looks for a match. It should be able to find one since the local directory number configured is 5551000 (along with the Tenor's country code of 1 and area code of 732).

It is important to check the normalized number and make sure that it will match to a local directory number or hop-off (LAM) that is configured in the Tenor. Be especially wary of the country code and area code. Many times, because other vendors do not follow the E.164 specification correctly, the Tenor may errantly insert the country code and area code onto the front of a number. For example if the Cisco sent the digits of 0114418155551234 for an international call to the UK (different application), the Tenor would not know what to do with this number because 011 is not part of an E.164 number format. When the Tenor goes to "normalize" the number it will put the country code and area code on in front of this number (17320114418155551234) which would not match to any pattern in the Tenor and it will not be able route correctly. In this case you will need to go to the config iptg# prompt and set the incdeldigits to 3 to delete the first 3 digits.

Other times, since the number coming from Cisco may not provide the correct E.164 format, the Tenor may put the country code and area code like below;

```
CH :195077038:Routing requested for: public(1) orig=17325551000 public(1) normalized=173217325551000 route code = .
```

In this case, you will need to delete 4 digits (incdeldigits = 4), but also prefix digits of 1732 (incpref=1732) This is because, when you use any of the incoming parameters in the IPTG, the Tenor will perform these tasks first and not perform any parsing (adding of country code and/or area code) of the number. You may need to play around with this to get the best results.

For calls that originate from the Tenor and go to the Cisco, the Tenor will always send the number of IP in the E.164 format (country code + area code + local number). This means that the Tenor will not send any prefixes, that may have been dialed, over IP. If the Cisco's dial peer configuration requires that you send a prefix, like the international prefix, then you will need to set the outprefix (in the IPTG prompt) to 011 and the Tenor will add this to the number before routing it. When you do this, you may need to change the dn or add a dn to the sroute you built earlier. The new dn should read 2: 011* 1 1 1, which sets the number to private.

VIII. Summary.

As you can see there are many issues that come in to play when performing interoperability with not only Cisco, but most any other vendor. The above information should assist you in most cases, but, as always, if you have any questions, or need further assistance, please don't hesitate to contact us.

IX. Appendix A

Extract of Appendix V of the ITU-T H.323 Version 4 Draft (11/2000)

Use of E.164 and ISO/IEC 11571 Numbering Plans

V.1 E.164 Numbering plan

ITU-T Recommendation defines E.164 numbers the following way for geographic areas:

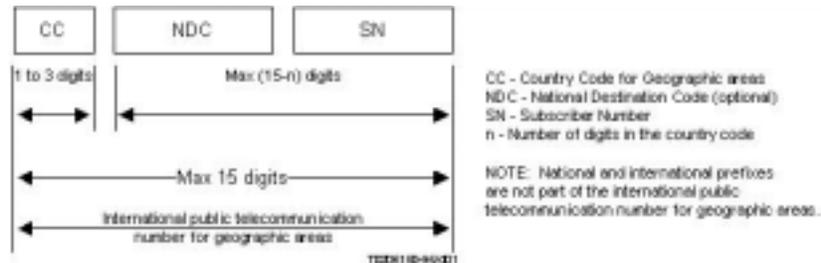


Figure V.1/H.323 - International public telecommunication number structure for geographic areas

Similar descriptions are also defined for non-geographic areas. Recommendation E.164 further defines country codes (CC) for all the countries and regions of the world.

An international E.164 number always starts with a country code and its total length is always 15 digits or less. More importantly, it does not include any prefixes that are part of a dialing plan (for example, “011 for an international call placed in North America, or “1” for a long-distance call), nor does it include “#” or “*”. The number “49 30 345 67 00” is a n E.164 number with CC=49 for Germany. A national number is the international number stripped of the country code, “30 345 67 00” in this case. The subscriber number is the national number stripped of the national destination code, “345 67 00” in this case.

An E.164 number has global significance: E.164 number can be reached from any location in the world. A “dialed digit sequence”, however, only has significance within a specific domain. Within a typical private numbering plan in an enterprise, for example, a prefix, such as “9”, may indicate that a call goes “outside”, at which point the local telephone company’s dialing plan takes over. Each telephone company or private network is free to choose its own dialing plan. It is also free to change it as it pleases – an frequently does so (adding new area codes, for example).

In a typical geographically determined network where user input telephone numbers manually and where user do not travel too much, having different dialing plans everywhere is usually a problem. However, when a user travels, the user must determine the other network’s numbering plan in order to place calls. When computer systems perform the dialing automatically, the user is usually required to customize the dialing software for every region or network.

Because of these issues with varying dialing plans and automated dialing, it is essential to be able to refer to an absolute “telephone number” instead of “what you have to dial to reach it from a specific location.” Proper usage of E.164 numbers can resolve these issues. Many systems use E.164 numbers instead of dialed digits: for example, a PBX may gather the dialed digits from a user on a telephone and then initiate a call to the local phone company using an E.164 number in the Called Party Number information element in Q.931. When completing the Called Party Number IE< specifying the numbering plan as “ISDN/telephony numbering plan (Recommendation E.164)” indicates an E.164 number. Specifying the type of number as “unknown” and specifying the numbering plan as “unknown” indicates dialed digits.

The following are a set of definitions from E.164:

A. Number

A string of decimal digits that uniquely indicates the public network termination point. The number contains the information necessary to route the call to this termination point.

A number can be in a format determined nationally or in an international format. The international format is known as the International Public Telecommunication Number which includes the country code and subsequent digits, but no the international prefix.

B. Numbering plan

A numbering plan specifies the format and structure of the numbers used within that plan. It typically consists of decimal digits segmented into groups in order to identify specific elements used for identification, routing and charging capabilities, e.g. within E.164 to identify countries, national destinations, and subscribers.

A numbering plan does not include prefixes, suffixes, and additional information required to complete a call.

The national numbering plan is the national implementation of the E.164 numbering plan.

C. Dialing plan

A string or combination of decimal digits, symbols, and additional information that define the method by which the numbering plan is used. A dialing plan includes the use of prefixes, suffixes, and additional information, supplemental to the numbering plan, required to complete the call.

Address

A string or combination of decimal digits, symbols, and additional information which identifies the specific termination point(s) of a connection in a public network(s) or, where applicable, in interconnected private network(s).

Prefix

A prefix is an indicator consisting of one or more digits, that allows the selection of different types of number formats, networks and/or service.

D. International prefix

A digit or combination of digits used to indicate that the number following is an International Public Telecommunication Number.

E. Country code (CC) for geographic areas

The combination of one, two or three digits identifying a specific country, countries in an integrated number plan, or a specific geographic area.

National (significant) number [N(S)N]

That portion of the number that follows the country code for geographic areas. The national (significant) number consists of the National Destination Code (NDC) followed by the Subscriber Number (SN). The function and format of the N(S)N is nationally determined.

National destination code (NDC)

A nationally optional code field, within the E.164 numbering plan, which combined with the Subscriber's Number (SN) will constitute the national (significant) number of the international public telecommunication number for geographic areas. The NDC will have a network and/or trunk code selection function.

The NDC can be a decimal digit or a combination of decimal digits (not including any prefix) identifying a numbering area within a country (or group of countries included in one integrated numbering plan or a specific geographic area) and/or network/services.

National (trunk) prefix

A digit or combination of digits used by a calling subscriber, making a call to a subscriber in his own country but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

Subscriber number (SN)

The number identifying a subscriber in a network or numbering area.

V.2 Private Network Number

Private Network Numbers are used in a private or virtual private telephony networks, e.g., a corporate network of PBXs and virtual private lines.

ISO/IEC 11571 defines Private Network Number (PNP) as having up to three regional levels.

A PNP number shall comprise a sequence of x decimal digits (0,1,2,3,4,5,6,7,8,9) with the possibility that different PNP numbers within the same PNP can have different values of x. Then maximum value of x shall be the same as for the public ISDN numbering plan, see ITU-T Recommendation E.164.

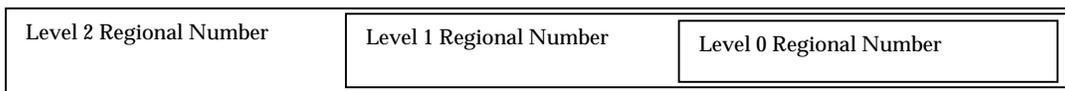


Figure V.2/H.323 – Structure of a PNP number with three levels of regions

A level n Regional Number (RN) shall have significance only within the level n region to which it applies. When that number is used outside that level n region, it shall be in the form of an RN of level greater than n. Only a Complete Number shall have significance throughout the entire PNP.

A typical example in North America would be a 4-digit “extension” as the Level 0 Regional Number: a 3-digit “location code” combined with the 4 digit “extension” would form the Level 1 Regional Number. The Level 2 Regional Number would be nil

A prefix could also be used to signal which regional number is used, and would not be part of the regional number per se, but only part of the dialing plan. Again, a typical example would be the use of digit “6” to access a Level 1 Regional Number, and no digit for a Level 0 Regional Number.

The following are a set of definitions from ISO/IEC 11571:

Private Numbering Plan (PNP)

The numbering plan explicitly relating to a particular private numbering domain, defined by the PISN Administrator of that domain.

Region

The entire domain or a sub-domain of a PNP. A region does not necessarily correspond to a geographical area of PISN.

Regional Number (RN)

A particular form of a PNP Number which is unambiguous in the region concerned.

Complete Number

A number which is unambiguous in the entire PNP, i.e. which corresponds to the highest regional level employed in that PISN.

V.3 H.323 version 1, 2 and 3 usage

H.323 version 1, 2 and 3 systems had a terminology problem with respect to dialed digits and real E.164 numbers. References to E.164 addresses in those version actually referred to dialed digits and not E.164 digits, as the names of the fields implied. In H.323 versions 2 and 3 systems, a real E.164 number was placed in the **publicNumber** field and not in the **e164** field. The **e164** field thus corresponded to a dialed digits sequence.

Beginning with H.323 Version 4 systems, the field **e164** was renamed to **dialedDigits** and the field **publicNumber** was renamed to **e164Number**. The name change was intended to more explicitly convey that dialed digits shall be stored in the **dialedDigits** field and the E.164 numbers shall be stored in the **e164Number** field.