## INx Codec Bandwidth Calculations

VolD Bondwidth Covingo with NOD		1							1		1					
VOIP Banuwium Savings with NOP														<b>↓</b>		
Notes: The calculations below show the line utilisation when using V	WIL'S NOP (Network Optimisation P	rotocol).												<b>↓</b>		
The calculations have been done for a variety of voice codecs. The	re are also two different silence treat	ments possible and these are	shown for each codec.											<b>↓</b>		
In order to reduce the amount of overhead some H323 equipment is	s set up to send 2 voice samples per	IP packet. This increases del	ay and has not been inclu	ded in this compariso	on.											
The calculations have been done assuming the bandwidth of one E	1 line is available															
The last but one line shows the precise compression ration that is a	chieved (compared to regular TDM t	raffic). The final line shows the	e MOS score achieved in t	testing (where known	)											
No. of packets per second	= Ir															
IP packet rate	= 33.3															
IP overhead for each packet (bytes) H323	= 40	Made up of 20 bytes IP head	er. 8 bytes UDP and 12 b	vtes RTP. Ethernet h	eader stripped by most	routers.										
IP overhead for each packet (bytes) NOP	= 29	Made up of 20 bytes IP head	er, 8 bytes UDP and 1 by	te NOP Message Tvr	pe. Ethernet header strin	oped by most routers.										
				ie i ie i inconse i j												
Voice packets per second (minimum delay)	– Vmin															
G7292	- 100	G729 Voice samples pormal	w 10mS long therefore 10	00 generated per sec	ond									<u> </u>		
All other algorithms (default)	- 33.3	Other Codec voice samples	normally 30mS long, there	of generated per sec	per second									<u> </u>		
	- 55:5	Other Obdec voice samples	normally soms long, mere	elore 33.5 generaled	per second									<u>├───</u>		
Vaice neckate new accord (ignoring delay)	V.													l		
Voice packets per second (ignoring delay)	= VI		and the second sec	la a la ala ala a ala a												
U/29d All other algorithms (default)	= 10.0000007	Il delay is ignored then H323	may carry multiple sample	les in a single packet										l		
All other algorithms (derault)	= 10.00000007													<b></b>		
														<u> </u>		
Voice packet size (bytes)	= Sv													1		
G723.1 (5.3Kbps)	= 20															
G723.1 (6.3Kbps)	= 24												-			
G729a	= 10										1	1				
G711	= 240											1				
		1														
Minimum voice sample length (mS)	= Mv	1														
G723.1	= 30	1 1														
G729a	= 10	<u> </u>												<u>├───</u>		
		<u> </u>												<u>├───</u>		
l ength of voice sample period per packet (mS)	- Ns	The longer the sample perior	the more efficient H323	will be however the	trade off is extra delay	NOP always has 30mS	delay							<u>├───</u>		
Turical	- 113	Enter comple length being up	a, the more encient 1020	nt hare	trade on is extra delay.	NOT always has sollio	uelay							t		
i ypicai	= 60	Enter sample length being u	sed by the H323 equipment	nit here										l		
	Nha													l		
Number of voice samples per packet (NS/MV)	= NV													<u> </u>		
G/23.1	= 2															
G729a	= 6															
Silence packet size (bytes)	= Ss															
G723.1 (5.3Kbps) no silence pkt	= 0													1		
G723.1 (5.3Kbps)	= 4															
G723.1 (6.3Kbps)	= 4															
G729a	= 2															
NOP micro header overhead (bytes)	= Om															
	- 4															
														<u> </u>		
Voice/Silence ratio	- r							Set un recommende	d	Set up recommended				<u> </u>		
								by MTL for bondwid	th coving	by MTL as Tall Quality				t		
VAD (Voice Activity Detection) active	= 0.5							by WIL for bandwid	un saving	by WIL as Toll Qual	y					
VAD Inactive	= 1	1100	11000	NOD	11000	NOR	11000		11000		11000	NOR	11000			
		NOP	H323	NOP	H323	NOP	H323	NOP	H323	NOP	H323	NOP	H323	NOP Ha	323	
The Calculations		G./23.1 (5.3Kbps) with G.	723.1 (5.3Kbps) with G	i./23.1 (5.3Kbps) G	6./23.1 (5.3Kbps) with	G./23.1 (5.3Kbps) G.	./23.1 (5.3Kbps)	G./23.1 (6.3Kbps)	G./23.1 (6.3Kbps)	G./23.1 (6.3Kbps)	a./23.1 (6.3Kbps) G./	29a (8Kbps) G./2	9a (8Kbps)	G./29a (8Kbps) G./29a	(8Kbps)	
		VAD & no silence pkts VA	AD & no silence pkts wi	ith VAD V	AD + silence pkt	without VAD wit	thout VAD	with VAD	with VAD	without VAD	without VAD with	VAD with	VAD	without VAD without	VAD	
IP packet rate - Ir	= 33.3	33.30	33 30	33 30	33 30	33 30	33.30	33 30	33 30	33 30	33 30	33 30	33 30	33.30	33 30	
IP overhead per second - Oh (H323)	= 40*lr	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00		00.00	55.00			
IP overhead per second - On (NOP)	= 29*lr	965 70		965 70		965 70		965 70		-		965 70		965 70		
Remember IP overhead on every voice packet for H322 many v	nice nackets per IP overhead for M	000.70		303.70		303.70		303.70				555.70		555.70		
Therefore Decket size must be asloulated for both access	ore packets per in overhead for h	<u> </u>								-				<u>├</u>		
Average voice packet size Thust be calculated for both cdSes	- Nu*(r*Qu - /1 -\*Qo) - OF	<u> </u>	60.00		70.00		00.00		76.00	-	00.00		04.00	<u> </u>	122.00	
Average voice packet size - FTI (Dytes) H323	$=$ INV (I SV + (I-F)^{-}SS) + OR	14.00	00.00	10.00	72.00	04.00	88.00	10.00	/0.00	00.00	90.00	10.00	84.00	14.00	132.00	
Average Pondwidth pervision call D (bits recorded)	= (1 SV + (1-f) SS) + OM	14.00	0000.00	10.00	0000 00	24.00	11700.00	18.00	10100.00	28.00	10000.00	10.00	11000.00	11000.00	17600.00	
Average bandwidth per voice call - B (bits per second)	= Provine or Provinee	3/29.60	00.0008	4262.40	9600.00	6393.60	11/33.33	4795.20	10133.33	/459.20	12800.00	8000.00	11200.00	11200.00 1	/000.00	
INETWORK BANGWIGTH - W (E1: 30 X 64Kbps)		1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00	1920000.00 192	.0000.00	
Iviaximum no. of voice channels per bandwidth - N	= (vv-On)/B	513.00	240.00	449.00	200.00	300.00	164.00	401.00	190.00	258.00	150.00	240.00	1/2.00	1/2.00	110.00	
I otal IP packet size - I	= N*Pn*(Vmin/Ir)+29	7211.00		7213.00		7229.00		7247.00		7253.00		7236.21		7260.23		
It I > 1200 (max. packet size), overhead increases. Only relevant for	NOP case													<u> </u>		
The corrected overhead - Ix	= (l/1200+1)*lr	233.41		233.46		233.90		234.40		234.57		234.10		234.77		
O, N will be recalculated																
Recalculated On	= 29*lx	6768.75		6770.36		6783.24		6797.72		6802.55		6789.04		6808.37		
Recalculated N	= (W-O)/B	500.00		438.00		292.00		389.00		250.00		233.00		167.00		
The compression ratio - C	= N*64000/W	16.67	8.00	14.60	6.67	9.73	5.47	12.97	6.33	8.33	5.00	7.77	5.73	5.57	3.67	
MOS		Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	4.2	Not Available	lot Available No	ot Available	4 Not A	vailable	
Additional Delay = wait for voice sample(s) + transmission time	(milli Seconds)	5	30.25	5	30.3	5	30.37	5	30.32	5	30.4	25	50.35	25 50	.55	
		1														
VAD (Voice Activity Detection) is the decision whether to treat speed	ch and silence differently in the enco	ding process.														
If VAD is on it means that the codec will try to detect silence during	the conversation.	3,														
There is then a choice of how that silence should be handled		<u> </u>												<u>├───</u>		
Fither no packets are sent at all (lowest bandwidth consumed but of	ves unnatural experience to listener	) or special silence packets m	av he sent which are then	turned into 'comfort r	noise' at play out									<u> </u>		
builde are sent at an newest sandwidth consumed but gi		, c. opeoid: bilerioe paonets life	., 30 30.11 WINDI ALC LIGHT											<u>├───</u>		
Calculation assumes a bandwidth of 1 v E1. Change Dow, 61 to find	the capacity at different bandwidth													<u>├</u> ───		
Calculation has a variable for the longth of the U202 complet. The lo	nder the sample, the more may be f	uitted in a single IP Packet PU	this will increase delay w	hich will make the ve	er experience much we	reo								<u>├</u>		
Calculation has a variable for the length of the h323 sample. The lo	inger the sample, the more may be f	ILEG III A SIIIYIE IF FACKE[ BUI	una wiii increase delay w	mon will make the us	er experience much Wol	30.								<u>├───</u>		
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		7.01												├		
		,,,														