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PTPv2 Today

- Chronos has experience in telecom synchronisation deployments in UK and Scandinavia
- Many operators have deployed PTPv2 to varying degrees
 - Slave clocks from various vendors giving required performance
 - Still more deployments to come as backbone/core networks are upgraded
- Leased-line or 3rd Party Backhaul means testing of PTPv2 is still happening in lab/field trials, even using previously tested equipment
 - Demarcation points for responsibility for sync quality can differ on site-by-site basis depending on backhaul
- Future 'phase' requirements are beginning to appear on the radar...





PTPv2 Status



- PTPv2 now fully trialled by a most operators and deployed by many
- Still noticeable variation in slave clock performance between vendors
 - Many operators have multiple vendors Slave clocks at different points
 - Packet metrics and packet KPIs are not standardised, making network comparisons difficult
 - Perform differently under identical network conditions
- Use of long-term sync monitoring solutions at selected sites of interest give confidence
 - Furthest from GM
 - High traffic

No	Time	Source	Destination	Protocol	Info
	6 3.260135	192.168.1.11	192.168.1.12	PTPv2	Announce Message
	8 3 791369	192.168.1.11	192.168.1.12	PTPV2 PTPV2	Sync Message
-	9 3.795499	192.168.1.8	192.168.1.5	TELNET	Telnet Data
Fran	ie 37 (106 by	rtes on wire, 106 by	ytes captured)		
Ethe	rnet II, Sro	:: Symmetri_01:31:b	5 (00:b0:ae:01:31:b6),	Dst: Symmetr	i_01:31:a5 (00:b0
Inte	rnet Protoco	ol, Src: 192.168.1.:	L1 (192.168.1.11), Dst	: 192.168.1.1	2 (192.168.1.12)
User	Datagram Pr	otocol, Src Port:	otp-general (320), Dst	Port: ptp-ge	eneral (320)
Prec	ision Time F	Protocol (IEEE1588)			
÷ 00	00 = tr	ansportSpecific: 0	k00		
	1011 - me	ssageId: Announce #	4essage (0x0b)		
	0010 = ve	ersionPTP: 2			
me	ssageLength:	64			
su	bdoma i nNumbe	er: 0			
🗉 f1	ags: 0x043c				
	0	PTP_SECU	RITY: False		
	.0	= PTP prof	ile Specific 2: False		
		= PTP prof	ile specific 1: False		
		= PTP_UNIC	AST: True		
		= PTP_TWO_S	STEP: False		
	0	= PTP_ALTER	RNATE_MASTER: False		
	TIME TRACEABLE: True				
	1 = PTP_TIMESCALE: True				
			REASONABLE: True		
			9: False		
			L: False		
m co	crection: 0	000000 nanoseconds			
c	ockTdentity	0x00b0aefffe00000	5		
50	UncePort TD:	1			
	quenceTd: 1(50			
		1.1.7			



What's Gone Right?



- Initial concerns regarding possible performance appear to have been unfounded
 - Operators are able to engineer networks to give required slave clock performance
 - Some vendors forced to upgrade oscillator types in their slave-clock equipment to give in-specification performance
- Interoperability was a problem in early deployments, however it is rare to see any issues like this nowadays
 - Clock_class / traceability flags caused problems
 - G.8265.1 has helped to eliminate these



- On-path support has not been needed to give required performance for frequency applications
 - Phase synchronisation may require this testing required

Current Problems & Issues



- Correlation of slave performance and network environment sometimes difficult
 - Especially if 3rd party backhaul is used as it is hard to get information about specific network conditions or events
- The G.826x standards have evolved at different times, relevant parts for PTP testing or deployment span more than one standards document
- Site sharing amongst operators and use of different base stations for 2G/3G/4G radios mean varying methods of sync delivery
 - Can mean daisy-chaining sync physically on site
 provides single point of failure



Network Perspective



- In general, the transmission type or equipment types have not been a major issue
 - No major changes have been forced upon operators
- Operators putting PTP GM's at most if not all MSC/RNC locations in the network
 - UK/Scandinavia networks are physically small enough for this to be commercially viable
- Floor Packet Percentage metric for network performance, now standardised but many operators still using empirical methods to test performance
 - Test at 'worst' case sites
 - Extensive field trials





Selected Events of Note

Measured During Trials

Ethernet Line Card PDV



- Some Ethernet line cards can add more PDV than an extra 'hop'
- Example of this mobile operator monitoring the measured flow stats at slave clock noticed unusually high 'Max IPDV' statistic...
- ….Isolated it to a 1G line card and removed this from path by using another switch to perform the required link speed change before problem card
- This added a network 'hop' but <u>reduced</u> max IPDV seen at slave clock by 20µs





IPDV at Slave – Line Card Changed



- IPDV Measurements were made by slave clock only. Slave TIE had GPS reference.
- Forward IPDV now greater than reverse (normal) another 'feature' of line card?
- Slave Clock TIE (E1 test point). Shows better medium/long term stability.
- All results also show diurnal increase/decrease in IPDV due to overall network traffic



Variations in Slave Clock Performance

- Very noticeable variations in Slave clock performance, even in identical network conditions.
- Testing performed Dec 2012 at cellsite
- Network event floor step in 3rd party backhaul network – unknown cause
- Red Slave Clock only affected by small amount
- Blue Slave Clock appears to 'unlock' before stabilising again over a short period of time
- Even now detailed testing is necessary



'Reverse Spikes' PDV Issue



- Point-to-Point radio link
- Issue with 7MHz channels smallest on-air channel size periodic processing event spaced approx 150s apart and are 10s in duration.
 - Generates 'reverse spikes' of PDV where all packets experience much less than the average delay
- Anomaly is that as traffic loading increased, actually the FPP got better up to a point!
- Graph below shows traffic load step from 0% to 20%
- Vendor had to change the way the system processes ALL packets to eliminate this phenomenon



GPS Interference Problems





- Issue with timing receiver this site
 - Customer installed GPS antenna
- GPS input only seeing 1 or 2 satellites and losing signal 'ock every 5 minutes during the day
- Curiously there were no problems overnight...
- The air conditioning was turned off at night!

Parting Thoughts...



- No major drama... so far
 - But a lot of effort put into modelling, testing, measuring.
- Continual monitoring essential as traffic loading profiles, equipment f/w levels & network architectures change over the long term





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