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Webinar Q&A Session for:
PTP Telecom Profiles for Frequency, Phase and Time Synchronization

The following answers were provided by Tim Frost, Principal Technologist.

Question: Slave time offset, should it not be equal to (t2-t1) instead of (t1-t2)?
Answer: Actually both are true - it is the sign that is different.
You can calculate the offset as:
offset = (t1 + OWD) – t2 = (t1-t2)/2 + (t4-t3/2) [as in the slide]
or
offset = t2 – (t1 + OWD) = (t2-t1)/2 – (t4-t3/2)
The sign of the offset is different; in the first case, it must be added to the slave time, in the second case it must be subtracted

Question: Secondly hardware stamping method reduces the processing and computation load from the centralized CPU of the device to the line cards, right?
Answer: Possibly true, but the main reason is to eliminate the delays through the protocol stack.

Question: Is it possible for a PTP BC to receive lesser frame/sec PTP messages and generate a higher frame/sec PTP output?
Answer: This is legal in IEEE1588-2008, but it has been decided in G.8275.1 to use a single message rate of 16 msgs/s.

This is somewhat arbitrary, and is largely driven by the decision to use 0.1Hz filtering in the BC – the sample rate must therefore be higher than the cut-off frequency, and a ratio of at least 100:1 was used.

Question: p2p transparent clock seems to be superior to e2e one since it calculates residence and the propagation delay. In what scenario would e2e be better to use?
Answer: P2P TCs would appear to be more accurate because it includes the link delays. However, it does mean an implementation must use a complete chain of P2P TCs.

Question: How do transparent clocks estimate the residence time? I mean... do they do an accurate measurement on each packet or use a general/ statistical estimation?
Answer: All implementations I am aware of use an accurate measurement on every packet, noting the arrival time and departure time, and using that to correct for the delay. Average or estimated delay would not be very useful, in my opinion.

Question: Does LTE standard not give the phase accuracy needed?
Answer: 3GPP defined the accuracy required for carrier frequency, and for phase difference between overlapping base stations in TDD systems. 3GPP2 defined the time accuracy for CDMA and CDMA2000 systems.

3GPP has not defined the time/phase accuracy for LTE-A features, such as eICIC, CoMP (various flavors), LTE MBSFN (it is defined for 3G MBSFN). Any figures that are quoted are therefore vendor figures.

Mostly this is because there is always a tradeoff – do you use up guardband to place basestations further apart? Or to allow looser time/phase sync? What loss of throughput can an operator tolerate? Can you accept lower throughput for looser time/phase sync?

Therefore there is no "right" answer, although the level for most of these techniques appears to be in the 1- 5us range, so similar to that required for TDD at 1.5us time synchronization.

Question: Is there any particular standard that defines jitter tolerance for 2G/3G/LTE BTS?
Answer: For 2G/3G, base stations simply re-used T1 or E1 signals for timing, so had to accept the jitter levels associated with these interfaces. Since most basestations had very stable oscillators and heavily filtered the sync input, jitter levels were not usually a problem.

I am not aware that any jitter specification on the sync input has been defined for LTE, or now that many operators are using packet-based sync rather than PDH.

Question: Does the latency (end to end delay) affect the synchronization quality or is it just the jitter/packet delay variation that affects the synchronization quality?
Answer: Latency is not an issue for sync, it is variable delay that affects the sync quality.

Latency is an issue for other aspects of mobile cellular systems, and these define the backhaul latency requirements rather than the sync.

Question: SSM is part of syncE, is it part of PTP as well?
Answer: It is not defined in IEEE1588-2008, although the PTP clockClass value serves a similar purpose, i.e. traceability.

In the G.8265.1 Telecom Profile, SSM is carried through the PTP using the PTP clockClass, in a set of reserved values defined in the profile itself. This enables end-to-end traceability in exactly the same way as SSM, and allows hybrid physical/packet sync systems to be built with no loss of traceability.

Question: Unicast = Puts load of PTP messaging on the GM
Answer: Yes, this is true, but the alternative of multicast was decided to be much harder to provision.

Secondly, many of the multicast messages in PTP are in fact only intended for one device (e.g. delay_req/delay_response). If transmitted in multicast, they will go to all PTP clocks in the domain, and are processed up the protocol stack to the PTP layer, and then rejected as not being applicable. This causes a huge overhead in processing to move up the protocol stack.

For example, imagine a system with one GM and 2000 slaves. In multicast, the GM just sends out one set of sync messages, but receives separate delay_requests from 2000 slaves.

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Each of those 2000 slaves will see the delay_requests from every other slave, because they are on the same multicast address. It will process them up the protocol stack and then reject them. The processing overhead kills the slaves, which are intended to be small, light, cheap devices.

So using unicast possibly doubles the overhead on the GM, but increases the overhead on every slave by up to 2000.

Question: Multicast = offloads GMC and load the network devices
Answer: Yes, see answer above as to why multicast is bad for slaves.

I should point out that if boundary clocks are used, the equation is very different, since the slaves only see messages from its local boundary clock, but in G.8265.1 there are no boundary clocks, hence a multicast message would be seen by everyone.

Question: its a tradeoff
Answer: See above.

Question: What is a typical holderover time for 2G/3G BTS?
Answer: I think you need to ask that question of a basestation manufacturer!

Question: And once it concludes that PTSF is unusable, will it continue to excahange both sync, delay-req and delay-resp ?
Answer : Probably yes, because it may only be temporarily unusable, e.g. because of transient congestion.

Question: Is there any provision in the telecom slave clocks to use two different sych methods in protection mode. Like primary source being PTP telecom profile and incase of failure, it may resort to local GPS based clock receiver?
Answer: Many slaves do this, but it is outside the scope of the Telecom Profile. Hybrid schemes such as this are vendor-specific.

Question: So does 1588-2008 mandate automatic switch in this case?
Answer: Not sure which case you are referring to. If you are talking about the various PTSF failures, these are Telecom Profile specific. The PTSF failures are defined in G.8265.1, not IEEE1588-2008.

Question: Having 100ms for network asymmetry seems a little ambitious as there can be 'few' hundreds km of fiber between BC and slave.
Answer: The purpose of the 100ns asymmetry compensation is not to cover the whole asymmetry of the network links. These can be very much greater than 100ns – China Mobile presented some figures to the ITU where they measured asymmetry on individual links at well over 100ns.

The 100ns is for any error in the asymmetry compensation. The asymmetry must be measured and compensated for. This is something PTP cannot do automatically: the estimate of the one-way delay is based on the assumption of symmetry.

Question: Will PDV play any role in network asymmetry?
Answer: PDV can produce asymmetry, for example if the PDV is different in the forward and the reverse direction, that might yield an asymmetric delay.

In general though, PDV is dynamic and can be filtered, whereas factors such as differences in link delays are constant and cannot be filtered.

Question: What are the (loose) limits of the network size for PTP to function properly, in terms of delay, number of hops, boundary and/or transparent clocks?
Answer: Very loosely: for frequency (G.8265.1), typical size might be 10 switches/routers between GM and slave.
For time/phase, G.8275.1 also assumes 10 boundary clocks (although simulations have shown up to 20).
For G.8275.2, it has yet to be determined, but is likely to be much lower numbers of unassisted switches/routers.

Question: Will there also be GM redundancy schemes in G.8275.1?
Answer: Yes, a new BMCA has been defined, and will be finalized at the July meeting.

Question: 8275.1: What is the relationship with IEEE802.1AS profile?
Answer: None at present, except that some of the contributors to 802.1AS also contribute to G.8275.1.

Question: Hi Tim. About the next generation of PTP: G.8275.1 and G.8275.2. Will they be compatible with the 1588v2 equipments?
Answer: If you mean equipment already in the marketplace, it is likely that such equipment will be capable of being configured to implement most of the features. Some features may require software upgrades.

Question: Would TC be more accurate compared to BC, as BC accumulated errors are permanent, while TC is transient?_
Answer: That's certainly what some vendors are saying, although to a large extent it depends on how they are implemented. Under certain constraints, it can be shown that the two are mathematically similar, so I don't believe there are any fundamental reasons why one should be better than another.

BCs may be easier to manage than TCs, since it is possible to identify if a given BC is not working properly – its output can be measured.

With a TC, there is just one correction field, so if that value is wrong, it is impossible to say which TC put the wrong value in (or possibly all of them did?).

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Question: What is the recommended synchronization strategy for synchronizing Base stations connected through VSAT (Satellite links)? Can we use transparent PTP? the round trip delay may be around 500ms.
Answer: Latency is not the issue, it is PDV that is more important. If only frequency is required, I am aware of some satellite modem vendors using the physical layer carrier frequency to regenerate the PTP at the remote terminal, and not actually carrying the PTP over the link.

Time/phase might be more problematic because of the PDV issue. However, if the basestation is using satellite backhaul, that implies there is a good clear view of the sky, so GNSS might be a more suitable means of obtaining time/phase sync.

Question: I work in a telecom company that has the following problems with 2G BS with IP transport: Packet loss (ICMP test), robotic voice, in general poor quality of voice from the user perception. Are these problems generated by Sincronism.
Answer: Packet loss is not generally caused by poor synchronization. Packet-based synchronization schemes tolerate very high packet loss – in general they are much more tolerant of packet loss than any other applications.

I would think that the poor voice quality may be linked to the packet loss, so it would be worth checking the cause of that.

Question: Most of the operatros expect symmetry fiber, what is the reason for asymmetry on the cable?
Answer: Typically with Ethernet, the forward and reverse paths are carried on different fiber links. Even if these fibers are carried in the same bundle, there may be a slightly different length to the fiber, causing different delays. Add in patches, fiber cuts, splices etc, and it is quickly possibly to build up 10s of nanoseconds difference in delay.