Recent Advances in Continuous On-line Synchronisation Testing for Telecom Networks

Christian Farrow
Technical Services Manager
Chronos Technology Ltd.
Lydbrook, UK
Christian.farrow@chronos.co.uk

***Abstract*— Poor synchronisation in telecommunication networks causes service degradation and even failure. Traditionally, the process of measuring the quality of synchronisation delivery has been complex; it requires dedicated, expensive equipment and detailed knowledge of the relevant International Standards for different nodes within any telecom network. Also, synchronisation knowledge has been confined to a small number of engineers in any given organisation, with synchronisation often seen as a niche discipline, under-funded and under-developed. Deploying these valuable and limited resources around a network with suspected synchronisation problems has in the past been a lengthy and costly exercise, typically in response to a major network outage. This paper will discuss a novel approach of widely deploying a number of remote synchronisation measurement probes around a network and propose that synchronisation measurement should become integrated within the network itself.**

I. Introduction

Typical standalone synchronisation test solutions are expensive and usually bulky pieces of equipment. Some SDH or Network Transport testers can also feature (usually at an extra cost) synchronisation testing capability, but the resolution and accuracy of non-dedicated solutions limits the justification for deploying these.

Transient events, such as those manifested by synchronisation problems, are by their very nature difficult to capture. Any Engineer who has been deployed to investigate a synchronisation problem will have a lengthy catalogue of anecdotal reports; typically of how the test equipment was deployed, setup (sometimes a lengthy & detailed procedure in itself) and then left on-site capturing data for hours, sometimes days – only to find that the problem did not occur – predictably to appear only hours after the equipment was disconnected and in transit on its way to the lab!

So, the problem is that to capture these transient events the synchronisation monitoring equipment needs to be connected 24 hours a day, 7 days a week and at multiple points in the network. The sheer cost of traditional stand-alone sync test sets means that this is financially unfeasible, especially for a large number of test/access points.

Using a large number of measurement points in a Network has previously been implausible not only due to the cost of traditional test equipment, but also do to the collection and collation of the measured data. Traditional tests sets do not usually have remote access capability and data collection would mean physically collecting files from the unit via a floppy disk for example.

II. 24 x 7 Sync Monitoring System

To address these problems a system has been designed that features low-cost measurement probes, that can be deployed at many locations around a network and left permanently connected (or as long as is needed to track down a particular problem). These probes all communicate with a central server, which contains a database holding configuration and performance information for each node. The system is interrogated, configured and controlled via this central server, over a standard HTTP web interface, as shown in Fig. 1.

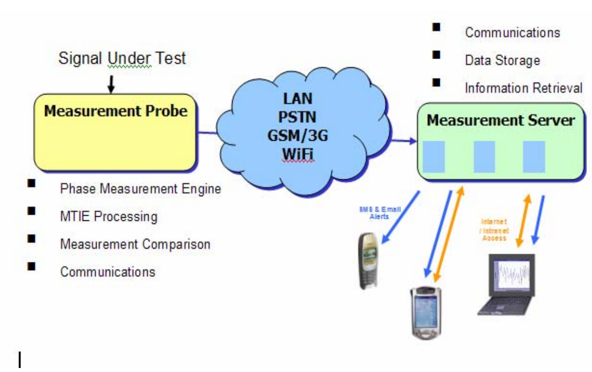

Figure 1. System overview

Each probe contains a Time Interval Error (TIE) measurement engine that is continually measuring the quality of a synchronisation signal either against either another external reference, or against a GPS Disciplined Oscillator (GPSDO) internal to the probe. From these measurements the probe calculates the Maximum Time Interval Error (MTIE)[1][2] - a standard metric used to define telecom synchronisation quality. An internal processing utility performs this MTIE calculation every second, and also handles management of the probe hardware and various communications options. The probe has an MTIE mask set – an acceptable level of performance below which the probe will send only a heartbeat to the central server, confirming correct operation and a clear communications path.

Should the synchronisation quality fall below what is acceptable for a particular measurement location then the fact is immediately reported to the server, along with a snapshot of the TIE data centred around the time the anomaly occurred. Raw TIE data can be very useful is diagnosing the source of the synchronisation anomaly.

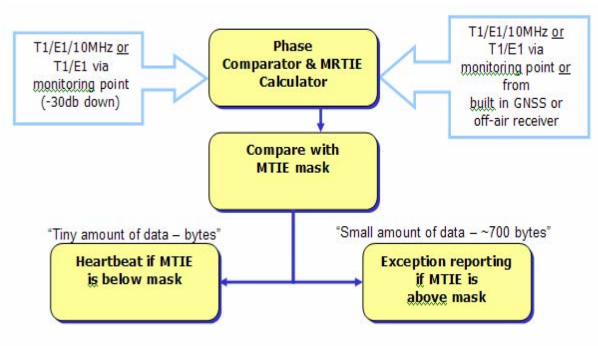

Figure 2. Measurement Probe Overview

The probe is also designed to be simple to install – a simple one-off configuration tells the probe where & how to contact the server (this configures the ip address of the server, and the particular communications medium to use i.e. Ethernet, GSM, GPRS or WiFi). On first power up the probe then contacts the server for its "personality" – configuring measurement signal types and acceptable MTIE levels.

The server is the central interface by which the network operator interacts with the system. A standard website interface is used to configure each probe location, and also view the performance data for each probe location. Each occurrence of unacceptable performance is termed an exception, and the server can be configured to send an email, SMS or SNMP trap on each exception. This provides flexible integration options for the system into existing telecom network management systems. Standard performance masks from the relevant standards are included in the reporting display so that network performance can be quickly and easily assessed.

Using a standard web interface enables access to the server over the internet or secure VPN, giving instant access to the sync experts wherever in the world they may be.

Using the system described above, a network operator can be absolutely sure of the synchronisation quality delivered to him by another network operator, at an interconnect gateway for example.

III. Service Level agreement defence scenario

A major carrier has deployed a large network for a private client. The synchronisation platform for this client consists of approx. 100 nodes. The client has negotiated a very aggressive SLA with the carrier, so the carrier wants to do everything within its capability to maintain detailed performance records about various aspects of the network to aid in its defence of this SLA. This suite of performance data includes synchronisation performance, so the carrier has deployed approx. 100 sync measurement probes, one at every main sync distribution point as a completely independent monitoring platform. Should a situation arise where there is a dispute over the root cause of a service outage, the carrier now has tangible evidence of the role that synchronisation may have played. As a bonus, the carrier now has an excellent additional early warning mechanism as when synchronisation problems occur they can be an indicator of degradation of network performance that could escalate to outages. The carrier can dispatch engineers to sites to investigate before any outage, rather the being purely reactionary..

IV. Wireless Deployment Scenario

In this scenario the System was used by a Mobile Network Operator (MNO) to measure the performance of the synchronisation delivery of their transport provider over a continuous extended period. The MNO wanted to validate the synchronisation performance and stability to ensure it met their requirements and was not causing service related problems on their 3rd Generation (3G) network roll out.

The MNO did not own their transport network but leased capacity from a fixed network provider. In many cases multiple network operators were used to provide this capacity increasing the variability of delivered synchronisation performance. In this case, the service offered by the fixed network provider included a statement that the 2Mbit/s interface supplied, to the MNO, was clocked from the fixed operator's synchronisation network. No detailed performance guarantees were provided. The MNO therefore wanted to measure the synchronisation performance to see if it met the requirements of the 3G base station equipment.

Although the mobile operator had the ability to take snap shots of the sync performance using his own portable test equipment, these testers were not be able to be dedicated to such tests or even be capable of making un-manned measurements over a longer period of time.

The measurements were made at a 3G base station, no other reference signals were available at the site so the measurement probe was deployed with a built in GPSDO.

The results were compared against the required network MTIE. Two sites were monitored one with a PDH delivery over a radio transmission system and the other using a SDH delivery system.

Continuous 24 x 7 monitoring enabled the MNO to validate synchronisation performance on a continuous basis right down to the base station in a cost effective manner. This enabled any issues with synchronisation performance to be detected and allowed corrective action to be instigated.

V. CONCLUSION

Cost effective continuous remote monitoring of Synchronisation quality is not feasible with traditional stand-alone synchronisation testers. The System described provides low-cost probes that can be deployed throughout a network at strategic or problem locations. The measurement a collection of data can be managed from a central location, and accessed from anywhere over internet, intranet and VPN making more efficient use of synchronisation knowledge and skills within an organisation.

[1] ITU G.810

[2] ETSI EN 300 462-1-1