



# INTERNATIONAL TELECOMMUNICATIONS SYNCHRONISATION FORUM

17<sup>th</sup> - 19<sup>th</sup> October 2005, IEE Savoy Place, London

Organised on behalf of the ITSF by The IEE Communication Networks and Services Professional Network

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**ITSF2005** was a great success bringing together key industry experts in Telecommunications Synchronisation together with operators and equipment suppliers. With over 120 attendees, more than ever before, the event provided the opportunity to discuss the latest sync and timing challenges facing telecommunications operators and the options available to tackle them.

The key issue at the conference was synchronisation in Next Generation Networks and it was clear that “Time” as well as “Timing” needs to be better understood and managed in these networks, if this is not done then crucial applications will suffer major quality of service issues. Such applications include Mobile Networks where a move to packet access offers potential benefits from a cost and flexibility perspective but will cause a disruption in the sync delivery mechanism.

The main conference was started with a welcome from the ITSF Chairman, Charles Curry of UK based Chronos Technology followed by a scene setting paper from Andy Reid, Chief Network Services Architect with BT entitled “Synchronisation Networks Today and Tomorrow”. Andy looked at some of the fundamental principles of Networks citing some of the early work done by Claude Shannon; with a network revolution occurring what are the underlying principles and what is information, he cited three basic types of information: a Message, a file and stream. Stating that it is for the requirements of the stream that we need timing/synchronisation to facilitate transfer of word times information. When we move to packet networks, synchronisation is not required for standard resource partitioning as it was in TDM networks but Sync is necessary at the edge to assist integrity of stream transport. There will also be new requirements like those to optimise CDMA or enable Location based services. Synchronisation is not a requirement itself but a **“means to an end”**.

As Next Generation Networks are introduced, defined by Andy Sutton of Three UK as “...packet based and optimised through traffic engineering...”, synchronisation is a key issue. Stefano Ruffini - Manager of Ericsson Synchronization Centre - Ericsson, Italy laid out the issues for this topic. Stefano highlighted two different sync aspects to be considered, firstly how to recover the timing to maintain constant bit rate (CBR) service QoS and secondly how to distribute network synchronisation in a packet network. He highlighted the issue of mobile network (GSM & UMTS) where sync is required to be distributed to the base station to distribute sync to the base station enabling a better than 50 ppb accuracy on the radio interface. This has been traditionally achieved using the E1 TDM leased line, but Stefano questioned how would we distribute sync to the base station over Ethernet?

Silvana Rodrigues System Architect - Zarlink, Canada introduced the key issues for synchronization in packet networks Explaining that although Packet Switched Networks (PSN) were designed to handle asynchronous data, the evolution of all services to Packet Networks will increase the need for transporting synchronization over these networks. She introduced the key methods of timing distribution over packet networks: Adaptive Clock Recovery, IEEE-1588, NTP and distributing synchronisation independently of the packet network using GPS, Loran C and in the future Galileo or distributing synchronization through the Ethernet physical layer.

Tim Frost of Zarlink Semiconductor System Architect in the UK addressed Circuit Emulation services over Packet (CESoP) in more detail explaining: Adaptive Clock Recovery where only the service packet information is used, Differential Clock Recovery where a network clock is required and Combination Clocking Scheme where a clock is distributed independently over the packet network. Tim also introduced the key topic of testing NGN sync solutions and impairments that need to be tested against Traffic modulation, On/off modulation, slow ramp in Packet Delay Variation (PDV), Routing changes, Network Overload and Network outages. Tim's conclusion was CES is a valuable technique for transporting TDM services over packet networks although careful design is required to ensure potentially disruptive effects in the packet network are properly handled. Good performance results were shown over the test network, meeting the stated requirements for both wireline and wireless telecom applications.

Alon Geva - Algorithms team leader - RAD Data Communications Ltd, Israel, explained how with Gaussian distributed packet delay it was very difficult to meet the existing sync distribution requirements in packet networks but in small networks a truncated distribution was normally seen with a significant number of packets seeing minimum delay and if this distribution can be assumed an alternative algorithm can be used realising enhanced performance.

Dave Tonks - Principle Engineer, Semtech, UK presented positive results of a IEEE 1588 field trial, performed on an extensive live network in the USA. The behaviour of the clocks was correlated with the behaviour of the network so that the impacts of, for example, variations in loading or path-switching events could be studied. The trial was conducted as a loopback over metro type devices, there was some doubt expressed from the delegates about how this would work over an access type network where symmetrical networks may not be the case due to firewalls, ADSL and other asymmetric bandwidth connectivity to wholesale applications. Dave also presented some of the limitations with the first version of IEEE1588 which are being addressed including the use of multicast messaging and the use of reduced bandwidth messages.

Michel Ouellette, Systems Architect, CRO Office, Nortel, Canada explained the testing that Nortel had done on Sync over packet solutions. He explained they monitored a number of key parameters including frequency accuracy and convergence time and tested a number of impairments including Packet delay variation distribution both symmetrical and asymmetrical on both a lab model and a Metro Network. Michel concluded that some solutions for timing over packet are looking promising, but testing is important. Differential timing is recommended when a reference clock exists (e.g, in the GPON case) but no standards for interoperability exist yet. Adaptive timing recovery is maturing, and at least one solution is looking promising so far (out of 4 vendors studied) but understanding packet-based network impairments is not sufficient, without considering the needs of the legacy products/services.

Vandana Upadhyay - Senior Director, Business Development, Symmetricom, USA explained how networks must be engineered to meet the most stringent requirements for transport and services (existing and proposed). In "all IP" networks, an accurate timing reference is needed for A/D conversion at the end-points (e.g. Set-top-box, IAD, ONU/ONT) for the interworking function for Circuit Emulation and for end applications. Different services will require different QoS and service level agreements and services must co-exist without impacting each other. For example, you can't drop a voice call when a movie starts playing, or vice versa, a mix of services on a single connection must be able to change dynamically as users start and end sessions.

Andy Sutton, WAN Specialist, Three, UK addressed the distribution of synchronisation in next generation networks, the move towards new access technologies and the needs of the end user applications. He questioned could synchronisation be supplied to applications at the edge of the network and would this be part of the general service offering or will sync be supplied as a service only to those customers who need it? He introduced the concept of Hybrid backhaul where not all bandwidth to the end user is via a packet network and this could be an interim step towards all Ethernet/IP transport. Andy questioned what happened when the E1s currently delivering synchronisation are no longer used. Will GPS be used or will sync be carried over layer 1, 2 or 3. He stated the decision will be based on the most cost-effective for the network operator (capex/opex) in the interim a hybrid solution may be the most attractive with at least one E1 to the base station supplying sync but larger bandwidth requirements like HSPDA being supplied by Ethernet access.

Kishan Sheno, Chief Technologist, Symmetricom, USA addressed the requirements of legacy services explaining that Fax and Modems requirements will necessitate good synchronisation at the A/D and D/A converters in the networks. If this is not achieved the frequency shift requirements and slip objectives will not be met

Antti Pietilainen, Senior R & D engineer at Nokia Research Centre, Finland gave a mobile manufactures perspective on synchronisation. Antti explained three requirement levels for mobile base stations, the 50-ppb frequency accuracy at the RF interface, the G.823/G.824 wander mask and the needs of time synchronized

systems. In future a packet timing standard is required but he explained that proprietary technologies will not succeed and a standards based solution is required. IEEE1588 is a good candidate because it provides the same as NTP and adds accuracy in a standard compliant network. A timing solution for mobile networks needs to be defined together with the SLA parameters the packet network needs to deliver to ensure required performance for the mobile network.

Laurent Montini, Consulting Engineer, Cisco, France explained that packet networks need the ability to transmit appropriate SYNCoP sessions to continue the support of existing non-packet services and to enable new services and applications. A platform requires a local clock distribution mechanism to support synchronization distribution and enable participation in SYNCoP architecture. The protocol providing the mechanism to transmit an accurate clock over a packet based network will depend on the telecoms requirements but there are issues with media independency and the Interworking Function (IWF) each of these elements will influence the design of the others.

Jean-Loup Ferrant, Standardisation manager & synchronisation expert in Alcatel Optical Network Division, Alcatel, France explained the impact of new technological changes on synchronisation transfer covering point-to point WDM systems and the introduction of G.709 Optical Transport Networks (OTN) based systems, 10 Gbit/s Ethernet interfaces and Multi Service Provisioning Platform (MSPP) combining TDM and Ethernet interfaces. Jean-Loop presented the issues raised by this evolution on the transport of timing on next generation equipment and the need for a clock to be defined for transport Ethernet equipment, the need for Ethernet chip vendors to allow access to the received clock. To distribute the clock this way also needs a traceability indicator to be defined and implemented.

David O'Connor, Managing Director, Horsebridge, UK explained key issues for planning today's Synchronisation Networks explaining every network should have a synchronisation plan detailing: the techniques employed in the network to distribute synchronisation, any limitations imposed by the behaviour of the network elements and any assumptions made. The plan should describe the synchronisation configuration of every synchronisation transporting element and predicted single points of failure.

David explained there is no single, correct way to synchronise a network, there are only shades of good & bad but a good sync plan should ensure the sync distribution, include protection, ensure optimum investment, be simple, documented and regularly re-evaluated.

Dilip Dhanda Product Line Manager – Network Management Systems, Symmetricom USA explained the basic functions of a Synchronisation Network Management System and explained how it can be used to reduce Opex and Capex with pro-active management.

Greg Mason, Technology Lead - Synchronisation & Transport Solutions, BT asked and answered a number of key questions on the management of synchronisation highlighting the need to actively manage and monitor synchronisation. For next generation networks he concluded synchronisation will be needed where flow rate is controlled or generated. In principle this is at the PSTN IP Gateway (PIG), Media servers, critical edge devices controlling packetization and at large routers with future 'Synchronous Ethernet' interfaces. He stated that some TDM interfaces will still persist on large routers with SDH interfaces and SDH VC4 switches still maintained for specific QoS dependent services.

Ian Wright, Professional Services Manager, Chronos Technology Limited, UK presented the need for synchronisation service level agreements to be specified and defined so operators can offer synchronisation to their customers with defined performance criteria including availability which is not currently defined for sync interfaces.

The conference agreed that there were sync problems to be overcome in Next Generation Networks and whilst solutions are potentially available, these need to be tested and proven during a panel session the question was asked if synchronisation was required in Next Generation Networks, "No, unless you want a decent quality of service" was Vandana Upadhyay's strong answer.

It was agreed to hold the ITSF again next year and proponents of novel in-band timing solutions who clashed with traditionalists at the IEE in London in 2005 will reconvene in Prague in the autumn of 2006. By the time ITSF 2006 takes place the entire telecommunications synchronization world will have been turned upside down. The impact of packet networks on edge applications such as mobile networks will be profound.

For further information please contact the Steering Group via the ITSF web site [www.telecom-sync.com](http://www.telecom-sync.com)