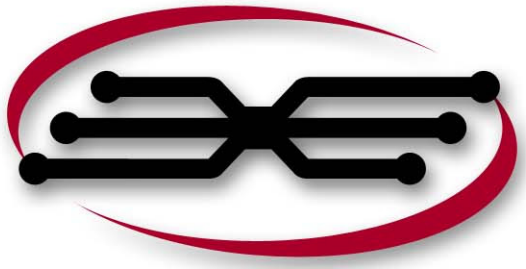


ZARLINK
SEMICONDUCTOR

An Overview of Standards Work on Synchronization over Packet

Silvana Rodrigues
System Architect
silvana.rodrigues@zarlink.com
http://timing.zarlink.com/
http://cesop.zarlink.com/

AGENDA

- Introducing IEEE-1588TM
- NTP
- ITU – Study group 15, question 13
- OPTXS.SYNC (former T1X1.3)

ZARLINK SEMICONDUCTOR

IEEE-1588™ is trademark of its respective owner

INTRODUCING IEEE-1588

- **IEEE-1588 – Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems**
  - The standard defines a Precision Time Protocol (PTP) designed to synchronize real-time clocks in a distributed system
  - Intended for local area networks using multicast communications (including Ethernet)
  - IEEE-1588 was designed to work within a building or factory environment

    Intended typically for industrial automation and test and measurement systems (synchronized printing presses)
  - Targeted accuracy of microsecond to sub-microsecond
  - Approved on September 2002 and published on November 2002
  - Available from the IEEE-1588 web site

    http://ieee1588.nist.gov/

INTRODUCING IEEE-1588

- **Three subgroups were active over the past year**
  - Technical Extensions Task Group
  - User Requirements Task Group
  - Conformance and Interpretation Task Group
- **During the September 2004 Workshop, it was decided to create a PAR (Project Authorization Request) to be presented to IEEE**
- **The PAR addresses several points including**
  - Resolution of known errors
  - Conformance enhancements
  - Enhancements to address new applications (including telecom)
- **The PAR was approved in March 2005**
  - P1588 – Precise Networked Clock Synchronization Working Group was formed

INTRODUCING IEEE-1588

- P1588 is meeting twice a month over conference calls
- Face-to-face meeting scheduled for July 13-15 at NIST in Gaithersburg
- IEEE 1588 Workshop will be Oct 10-12 in Winterthur, Switzerland

SOURCES FOR INACCURACY IN IEEE-1588

- **Requires accurate timestamps generation**
- **Requires stable oscillators**
  - The protocol only allows a minimum of 1 packet per second (pps) to be transmitted
- **Clock recovery algorithm is not defined in the standard**
  - It relies on proprietary implementation to guarantee performance
- **Assumes symmetric delay between the master and the slave**
  - Asymmetry introduces offset errors
- **Cascading devices through boundary clocks introduces errors**

IEEE-1588 ISSUES FOR TELECOM

- **IEEE-1588 only allows the values of sync interval to be 1, 2, 8, 16, and 64 seconds**
  - It is difficult to maintain performance in a loaded network with sync packet rate of 1pps and an inexpensive oscillator
- **IEEE-1588 relies on a symmetric network**
- **IEEE-1588 does not have provision for redundancy support**
  - In telecom applications clocks must be always available
- **IEEE-1588 relies on boundary clocks topology**
  - Boundary clocks are not available in current telecom networks
- **IEEE-1588 only supports multicast**
- **IEEE-1588 Message Format**
  - Long PTP messages consuming too much bandwidth

IEEE-1588 – HOW TO SUPPORT TELECOM

- **Enhancements for increased resolution and accuracy**
  - Allow shorter sync_intervals
- **Extensions to the standard to enable correction for asymmetry**
- **Extensions to the standard to enable implementation of redundant systems**
  - Deal with master clock failure and network failure
- **Prevention of errors accumulation in cascaded topologies**
  - Deal with boundary clock issues for telecom applications
- **Use of Unicast in addition to Multicast**
- **Small Frame, reduced message format**
- **Support for QoS**

1588 STANDARD WORK TO SUPPORT TELECOM

- **The work has started**
  - Two proposals for Short Frame Format for telecom applications
    - *One proposals that each slave determines the rate at which it receives timing information*
      - Needs to compromise for backwards compatibility with current standard
    - *Proposal to include Telecom Clock Quality in the frame*
      - E.G., slave knows that it is receiving a Stratum 1 traceable clock
  - Proposal to increase accuracy of the timestamps
    - *Add 2 more bytes for accuracy*

P1588 WORKING LIST

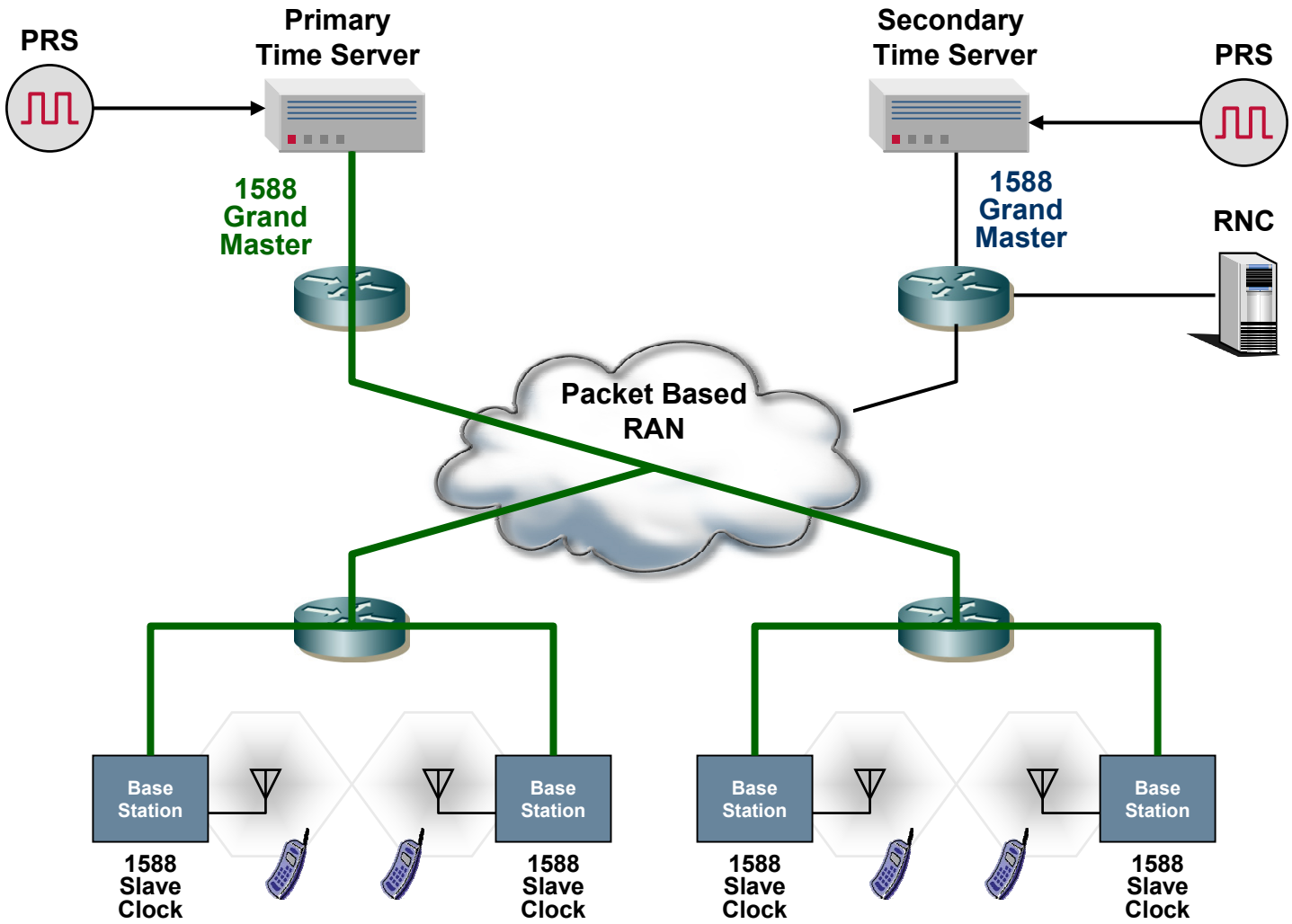
- Short frames
- Accuracy extension & asymmetry corrections
- QoS support – e.g. priority frames
- Annex D for IPV4 & IPV6
- Transparent clocks
- Conformance enhancements for testing
- Ethernet layer 2 mapping including VLAN
- Annex mapping to DeviceNet
- Management additions and SNMP
- Extensions to enable redundant systems
- Extension for fault tolerant systems: specifically redundant master clocks

ZARLINK SEMICONDUCTOR

P1588 WORKING LIST

- Revision of time to live field in IP headers for 1588
- Discussion of best practices, e.g. hardware assist, servo, filtering
- Unicast/multicast
- Security issues
- Status indicators
- Revise randomization algorithm
- Revise external timing signal physical specification

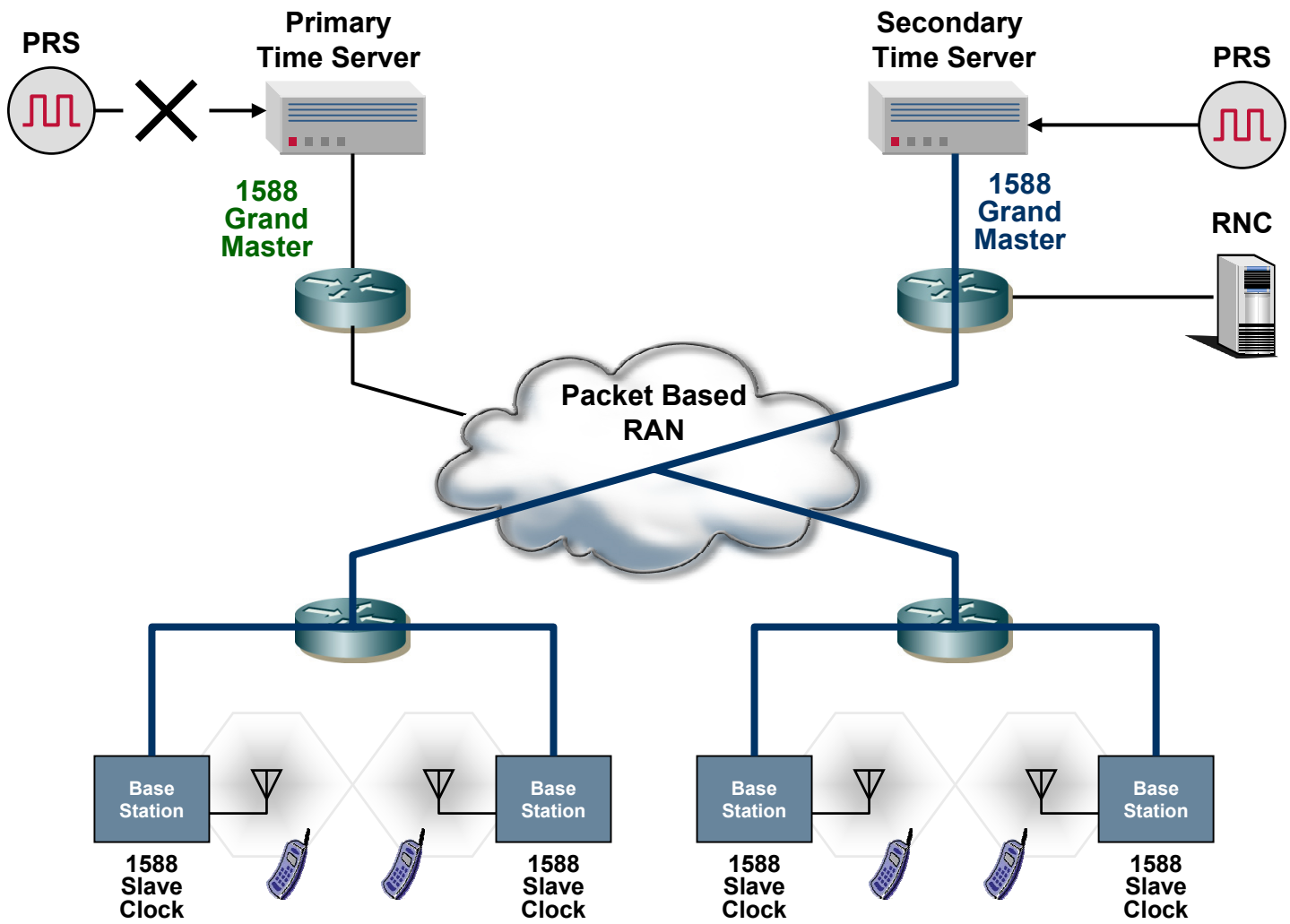
IEEE-1588* IN TELECOM



ZARLINK SEMICONDUCTOR

* With proper changes to the current standard

IEEE-1588* IN TELECOM



ZARLINK SEMICONDUCTOR

* With proper changes to the current standard

NTP

- **NTP version 3 is described in RFC 1305**
  - Designed to synchronize the computer clocks over the network

    Poor precision – accuracy in the order of milliseconds
- **Simple Network Time Protocol (SNTP) is described in RFC 2030**
  - It is an adaptation of the NTP

    Accuracy in the order of fractions of a second
- **NTP version 4 is currently being developed at IETF**
  - Working Group was formed in November 2004
  - RFC1305 was published in March 1992

    It remains unchanged at Draft Standard status
  - NTP community has been working on improvements

    This work is not yet reflected in the NTP standard

NTP

- **NTP version 4**
  - The IETF working group will identify modifications and additions to the NTP Protocol
  - It is backwards compatible with NTP version 3 and version 2
  - Represents a significant revision of the NTP version 3
    - *Support for IPv6*
    - *Adds security features*
    - *Automatic configuration*
    - *Algorithm improvements*
- **The IETF Working Group has the goal to produce a series of updated NTP specifications**
  - NTP Protocol specification
  - NTP Algorithm specification
  - NTP MIB

ITU, STUDY GROUP 15, QUESTION 13

- **October 2003 meeting**
  - Zarlink and Nortel presented a contribution proposing Q13 experts group start investigating precision synchronization requirements over asynchronous packet networks

    The contribution was accepted and the work on synchronization issues related to TDM over Ethernet was started
  - The conclusions of this meeting were that transport of TDM over packet needs to be compliant with existing TDM timing standards (G.823 and G.824 for PDH)
- **April 2004 meeting**
  - Work started on a single recommendation “G.pactiming: Timing and Synchronization aspects of Packet Networks”

ITU, STUDY GROUP 15, QUESTION 13

- **September 2004 meeting**
  - First draft of G.pactiming created
  - Network Reference Model for Timing Distribution over Switched Ethernet Networks was discussed based on a company contribution

    It was agreed at the meeting that modeling such equipment is a complex task needing further work
- **November 2004 meeting**
  - Progressed the work on G.pactiming
  - Several areas in the recommendation require further work

    Reference models need to be defined

    Annex A needs to be improved

    Model of Ethernet switch to allow simulation work to start
- **Next ITU meeting**
  - May 16-27 2005 in Geneva

    The group is interested in understanding IEEE-1588

ATIS – OPTXS

- **OPTXS-SYNCH (formerly T1X1.3)**
  - Working on a technical report “Synchronization of Packet Networks”

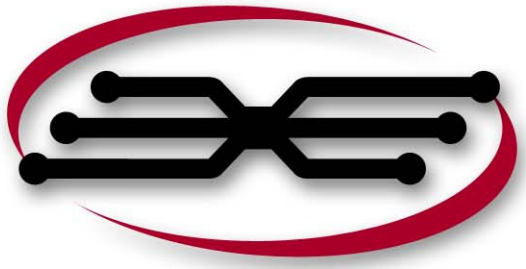
    The report addresses synchronization issues in packet networks
- **Last face-to-face meeting January 18-19, 2005**
  - Editorial work on the “Synchronization of Packet Networks” technical report
  - Several areas in the technical report require further work

    Companies need to contribute for work to progress
- **Conference calls during the week of April 11, 2005**
  - Progressed the work on ….
- **Next face-to-face meeting planned October 24-28**

ZARLINK SEMICONDUCTOR

CONCLUSION

- **As telecom networks continue to evolve to packet infrastructure, there is a need of transporting synchronization over asynchronous networks**
  - The work by the standards bodies will be crucial for this technology evolution to take place
- **Work on synchronization over packet networks is happening within several standards bodies**
  - Requires increased participation from telecom companies
- **An overview of the work being done on different standards bodies was presented**
  - IEEE-1588
  - NTP
  - ITU – Study group 15, question 13
  - OPTXS.SYNC (former T1X1.3)



ZARLINK
SEMICONDUCTOR

www.zarlink.com