International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 3 Issue 11, November 2014

Clock Synchronization in Distributed System

Ms.Rashmi Deshmukh , Ms.Ketki Bhakare , Ms.Jayashree Shiral, Ms.Rachana Deshmukh

[1] Asst. Professor, Computer Science & Engineering,DBACER,Nagpur,India
[2] Asst. Professor, Computer Science & Engineering,DBACER,Nagpur,India
[3] Asst. Professor, Computer Science & Engineering,DBACER,Nagpur,India
[4] Asst. Professor, Information Technology,GNITE,Nagpur,India

Abstract— In distributed systems, most of the end-to-end delay fluctuations, especially the delay fluctuations in the network, are bounded provided that the global network traffic loads are manually controlled to be light-weighted. Ethernet based communication protocols have recently gained more importance. The IEEE 1588 standard is the most widely used synchronization algorithm for Ethernet based communication protocols. The IEEE 1588 standard uses the centralized synchronization method. In this case, the malfunction of a specific node that sends the master clock can affect the performance of synchronization of every node on the network. The low synchronization performance of the nodes can cause malfunctions of the synchronous control system. For this reason, we believe the distributed synchronization method is more suitable for the industrial communication protocols.

***Index Terms*—Distributed, Ethernet, IEEE, Network.**

I. Introduction

In distributed control systems, a common notion of time of all nodes is fundamental for control, because it allows a consistent system view of dynamic environments and supports meaningful exchange of time-related data between clusters. This thesis presents a clock synchronization algorithm for multi-cluster systems that is especially suited for embedded control systems. The requirements of embedded systems are addressed by supporting increased

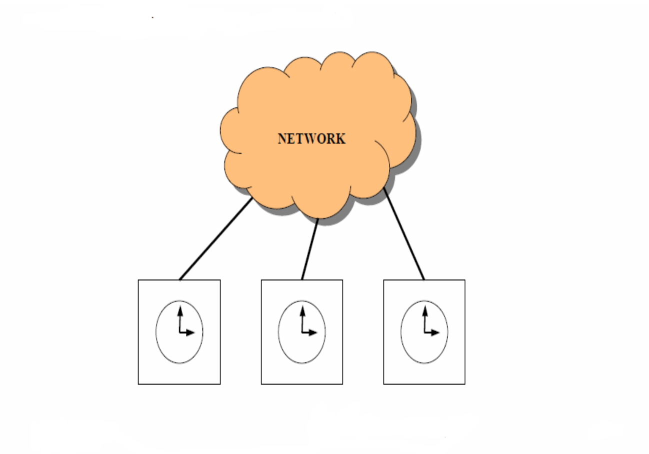

Fig1: Communicate using network

dependability necessities and decreased computing resources of embedded systems compared to desktop computer systems. Furthermore, the algorithm assures the composability of the cluster time bases, that is the precision of clusters is not worsened when several clusters are connected and synchronized.

By addressing systematic and stochastic errors of cluster times differently, the influence of systematic errors is eliminated and the quality of synchronization only depends on stochastic errors. Since systematic errors of cluster times are usually an order of magnitude larger than stochastic errors for typical real-time embedded control systems, the presented algorithm achieves a significant improvement to known synchronization algorithms. In the area of distributed computer systems and clock synchronization, the semantics of used terms differs due to the different range of application and purposes of distributed systems and clock synchronization.

II. . Basic Terms Related to clock synchronization

A. *Reference clock*: A reference clock is a dedicated clock that is used as a time (state)and frequency (rate) standard for a set of clocks under consideration.

B. *Clock drift rate*: The drift rate of a clock is the deviation of the frequency of this clock to the frequency of the reference clock.

C. *Cluster drift rate:* The drift rate of a cluster is the deviation of the frequency of the global time of this cluster to the frequency of the reference clock.

D. *Precision:*The precision is the maximum deviation in the state of any two clocks observed during a period of interest.

E. *Accuracy:* The accuracy is the maximum deviation in the state of any clock and the state of the reference clock observed during a period of interest.

F. *Reference Clock:*No single physical reference clock exits Each clock calculates deviation in respect to a virtual reference clock. Virtual reference clock established using distributed fault tolerant clock synchronization algorithm (fault-tolerant midpoint) combined use of offset correction and rate correction.

G. *Internal Clock Synchronization*:The process of mutual synchronization of an ensemble of clocks to maintain a bounded precision is called internal clock *synchronization*. Internal clock synchronization does not necessarily mean synchronization to real time, as all clocks of an ensemble can drift. Internal clock synchronization is defined optimal and if the

 All Rights Reserved © 2014 IJARCET

drift rate of the synchronized clock time of an ensemble of clocks (with respect to real time) is smaller than or equal to the drift rate of the largest drift rate of the ensemble of clocks.

H. *External Clock Synchronization*:If an ensemble of clocks synchronizes their clock times to distinguished clocks that are not part of this ensemble, this is called *external clock synchronization*. A quality measure for this kind of synchronization is the accuracy.

III. SYNCHRONIZATION ALGORITHM

In this section ,we describe the IEEE 1588 synchronization algorithm

A. IEEE 1588

IEEE 1588 provides a standard protocol for synchronizing clocks connected via a multicast capable network, such as Ethernet. Released as a standard in 2002, IEEE 1588 was designed to provide fault tolerant synchronization among heterogeneous networked clocks requiring little network bandwidth overhead, processing power, and administrative setup. IEEE 1588 provides this by defining a protocol known as the precision time protocol, or PTP.

A heterogeneous network of clocks is a network containing clocks of varying characteristics, such as the origin of a clock's time source, and the stability of the clock's frequency. The PTP protocol provides a fault tolerant method of synchronizing all participating clocks to the highest quality clock in the network.

IEEE 1588 is a Standard for Precision Clock Synchronization Protocol for Networked Measurement and Control Systems .It is also known as Precision Time Protocol [PTP] and is used for time/clock synchronization in packet-based networks that support multicasting. As the name states, this standard was originally introduced for testing and automation industry, to achieve synchronization accuracies in the order of sub microseconds. Later on, it gained popularity and several other groups are showing interest, telecommunication, electrical power distribution and military applications. The basic principle is that the most precise clock on the network synchronizes all other users. A grand master clock is located at the root of the hierarchy and is selected through so-called best master clock algorithm, based on the source of time it is connected . A PTP system includes several masters, serving groups of local clocks or slaves.

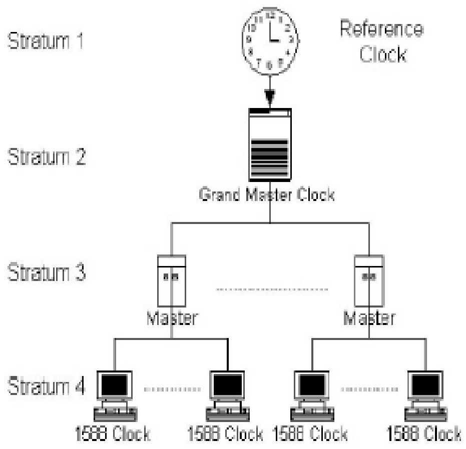

Fig2: Master –Slave Hiererachy in IEEE 1588

PTP uses stratum numbers similar to NTP and clock identifiers to describe the quality of a particular clock Stratum 1 clocks include an atomic clock, a GPS receiver or a high precision local oscillator. The maximum number allowed for stratum based classification is 256 with only fourbeing currently defined in the IEEE 1588 standard. A master sends continuous multicast messages to the slaves while slaves respond to the master by unicast messages. PTP is built over IP and UDP and uses several a variables to calculate the offset and delay of a local clock with reference to the master. The protocol uses basically four messages: Sync, Follow_Up,Delay_Request and Delay_ Response between a master and slaves. Sync and Delay_Request are used for time stamps, while the other two carry the precise time stamps from the master, respective the slave.

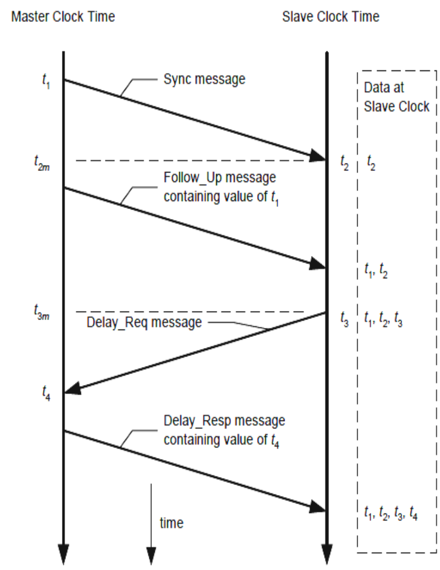

Fig3: PTP master –slave Hierarchy

Sync message:

- Issued by clocks in the 'Master' state.
- Contain clock characterization information.
- Contain an estimate of the ending time(~t1).

 All Rights Reserved © 2014 IJARCET

- When received by a slave clock the receipt time is noted.
- Can be distinguish from other legel message on the network.
- For best accuracy these messages can be easily identified and the precise sending (or receipt) time recorded.

B. *Follow_Up message:*

- Issued by clocks in the 'Master ' state
- Always associated with the preceding Sync message
- Contain the 'precise sending time=(t1)' as measured as close as possible to the physical layer of the network.
- When received by a slave clock the 'precise sending timr' is used in computations rather than the estimate sending time contained in the Sync message.

C. *Delay_Resp message*:

- Issued by clocks in the 'Master ' state
- Always associated with the preceding Delay_Req Sync message from a specific slave clock
- Contain the receipt time of the associated Delay_Req message(t4).
- When received by a slave clock the receipt time is noted and used in conjuction with the sending time of the associated Delay_Req message as part of the latency calculation Synchronization

.

REFERENCES

[1] IEEE Standard for "Enhancement for a clock Synchronization Protocol In heterogeneous Networks."ISPCS 2009 International IEEE Symposium on Precision Clock Synchronization fo Measurement Control and communication Brescia,Italy,Oct 12-16,2009.

[2] Santoshi kawanami,Takeshi nishimura,tonoya nokido,and makota takizawa "A scalable group communication protocol with global clock" Proceeding of the 19th International Conference on Advanced Informaion Networking and Application(AINA).2005 IEEE.

[3]Teodor Neagoe,Valentin Cristea, Logica Bania"NTP versus PTP IN computer networks clock synchronization".IEEE ISIE 2006.

[4] Pan Yulin,yao Xinyu " clock synchronization in distributed Real-Time simulation sysetm".First International Workshop On Education Technology and Computer Science 2009.

[5] G.Giorgi, C.Narduzzi "Performance analysis of filter-based clock synchronization in network" ISPCS 2009. International IEEE Symposium on Precision Clock Synchronization for Measurement Control and communication Brescia,Italy,Oct 12-16,2009.

[6] Young Youl Ha, Tae Jin Park " distributed clock synchronization algorithm for industrial network" .2010 IEEE.

[7] Astrit Ademaj , Hermann Kopetz " Time –triggered and IEEE 1588 Clock synchronization".2007.ISPCS International IEEE Symposium on Precision Clock Synchronization for Measurement Control and communication Vienna,Austria ,Oct 1-3,2007.

[8] Ruxandra Lupas Scheiterer, Dragan Obradovic " Synchronization performance of the Precision Time Protocol in the slave clock ".4th IEEE conference on Automation Science and engineering Key Bridge Mrriott ,Washington DC,USA August 23-23,2008

First Author Asst. Prof.Rashmi Deshmukh did M.Tech in Wireless Communication & Computing in 2012 .The international publication in Jouranl are 8 and 2 International Conference and 7 National conference.She is member of ISTE and IAENG. She registered the copyright of Operating System In Government of India.

Second Author Asst.Prof.Ketki Bhakare did M.Tech in Computer Science & Engineering in 2012 .The international publication in Jouranl are 8 .

Third Author Asst.Prof.Jayashree Shiral did M.Tech in Wireless Communication & Computing in 2012 She is member of ISTE. The international publication in Jouranl are 5 and 1International Conference and 2 National conference.

Fourth Author : Asst.Prof.Rachana Deshmukh did M.Tech in Information Technology in 2014.2 The international publication in Jouranl are 2 and 1 International Conference and 2 National conference.