

DCNET Internet Clock Service
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Introduction

Following is a description of the Internet Clock Service (ICS) provided by all DCNET hosts. The service, intended primarily for clock synchronization and one-way delay measurements with cooperating internet hosts, is provided using the Timestamp and Timestamp Reply messages of the proposed Internet Control Message Protocol (ICMP). In addition, in order to maintain compatibility with present systems, this service will be provided for a limited time using the Echo and Echo Reply messages of the Gateway-Gateway Protocol (GGP).

It should be understood that ICMP and GGP datagrams are normally considered tightly bound to the Internet Protocol (IP) itself and not directly accessible to the user on a TOPS-20 system, for example. These datagrams are treated somewhat differently from user datagrams in gateways and DCNET hosts in that certain internal queueing mechanisms are bypassed. Thus, they can be a useful tool in providing the most accurate and stable time reference. The prime motivation for this note is to promote the development of this service in other internet hosts and gateways so that the feasibility for its use throughout the community can be assessed.

ICS Datagrams and Timestamps

At present, the ICS is provided using either ICMP or GGP datagrams. The only difference between these is that ICMP uses protocol number 1 and GGP uses protocol number 3. In the following these will be referred to interchangeably as ICS datagrams. ICS datagrams include an internet header followed by an ICS header in the following format:

$(t_2 - t_1) + (t_4 - t_3)$ for the roundtrip. Note that, in the case of the roundtrip, the clock offsets between the sending host and DCNET host cancel.

Although ICS datagrams are returned by all DCNET hosts regardless of other connections that may be in use by that host at any given time, the most useful host will probably be the COMSAT-WWV virtual host at internet address [29,0,9,2], which is also the internet echo virtual host formerly called COMSAT-ECH. This virtual host is resident in the COMSAT-GAT physical host at internet address [29,0,1,2], which is connected to the ARPANET via the COMSAT Gateway, Clarksburg SIMP and a 4800-bps line to IMP 71 at BBN. The roundtrip delay via this path between the COMSAT-GAT host and the BBN Gateway is typically 550 milliseconds as the ICS datagram flies.

As in the case of all DCNET hosts, if the COMSAT-WWV virtual host is down (in this case possible only if the Spectracom radio clock is down or misbehaving) a "host not reachable" GGP datagram is returned. In unusual circumstances a "net not reachable" or "source quench" GGP datagram could be returned. Note that the references to "GGP" here will be read "ICMP" at some appropriate future time.

Local Offset Corrections

All DCNET timestamps are referenced to a designated virtual host called COMSAT-WWV (what else?) with internet address [29,0,9,2]. This host is equipped with a Spectracom radio clock which normally provides WWVB time and date to within a millisecond. The clock synchronization mechanism provides offset and drift corrections for other hosts relative to this host; however, offsets up to an appreciable fraction of a second routinely occur due to the difficulty of tracking with power-line clocks in some machines. A table of the current offsets can be obtained using the following procedure.

1. Connect to COMSAT-GAT host at internet address [29,0,1,2] using TELNET and local echo.
2. Send the command SET HOST HOST. A table with one line per DCNET host should be returned. Note the entry under the "Offset" column for the WWV host. This contains the offset in milliseconds that should be added to all timestamps generated by either the COMSAT-GAT or COMSAT-WWV hosts to yield the correct time as broadcast by WWVB.
3. Send the command SET WWV SHOW. A summary of datagram traffic is returned along with an entry labelled "NBS

time." The string following this is the last reply received from the Spectracom unit in the format:

```
<code> DDD HH:MM:SS TZ=00
```

where <code> is normally <SP> in case the WWVB signal is being received correctly or ? in case it is not. The DDD represents the day of the year and HH:MM:SS the time past UT midnight. The two digits following TZ= represent the time zone, here 00 for UT.

4. Close the connection (please!).

REFERENCES

[1] ICMP

Postel, J., "Internet Control Message Protocol", RFC 777, USC/Information Sciences Institute, April 1981.

[2] GGP

Strazisar, V., "How to Build a Gateway", IEN 109, Bolt Beranek and Newman, August 1979.

Following is a specification of the ICS header in PDP11 code:

```

;
; GGP/ICMP Header
;
.          =          0
GH.TYP:   .BLKB     1          ;Message type
GC.RPY   =          0          ;Echo reply
GC.UPD   =          1          ;Routing update
GC.ACK   =          2          ;Positive acknowledgment
GC.DNR   =          3          ;Destination unreachable
GC.SQN   =          4          ;Source quench
GC.RDR   =          5          ;Redirect
GC.ECH   =         10          ;Echo
GC.STA   =         11          ;Net interface status
GC.NAK   =         12          ;Negative acknowledgment
GC.TIM   =         15          ;Timestamp
GC.TRP   =         16          ;Timestamp Reply
GH.COD:   .BLKB     1          ;Message code
GH.SEQ:   .BLKW     1          ;Sequence number
GH.HDR   =          .          ;Beginning of original
          ;internet header
GH.ORG:   .BLKW     2          ;Originating timestamp
GH.REC:   .BLKW     2          ;Received timestamp
GH.XMT:   .BLKW     2          ;Transmitted timestamp
GH.LEN   =          .          ;End of timestamp header

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Note that all PDP11 word fields (.BLKW above) are "byte-swapped," that is, the order of byte transmission is the high-order byte followed by the low-order byte of the PDP11 word.