Will the INTERNET's Network Time Protocol Fail in 2000 or 2036?

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- **What is the Network Time Protocol (NTP)?**
  - **Used to synchronize computer clocks on the INTERNET and intranets**
  - **Has Top-level computers called Stratum 1 Primary Time Servers**
  - **Relies on multiple time sources (NIST, GPS, etc)**
  - **Transported via an INTERNET Protocol Packet**
  - **Uses client software to set the computer's local clock**
  - **Employs algorithms to account for multiple sources and network delays to increase accuracy and reliability**

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- **Who uses NTP?**
  - **Government, Military, National Labs**
  - **Universities**
  - **INTERNET Service Providers (ISP)**
  - **Network Providers**
  - **Industry**
  - **Computers on local networks**
  - **Personal Computer Users**

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- **What are the INTERNET Time Protocols?**
  - **INTERNET Control Message Protocol (ICMP)- RFC-792**
  - **Daytime Protocol- RFC-867**
  - **Time Protocol- RFC-868**
  - **Network Time Protocol Version 3 (NTP)- RFC-1305**
  - **Simple Network Time Protocol (SNTP)- RFC-1769**

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- **What are the INTERNET Time Protocols?**
  - **INTERNET Control Message Protocol (ICMP)- RFC-792**
    - **September 1981**
    - **32-bit unsigned milliseconds since midnight UTC**
    - **ICMP Message type 13, 14**
  - **Daytime Protocol- RFC-867**
  - **Time Protocol- RFC-868**
  - **Network Time Protocol Version 3 (NTP)- RFC-1305**
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  - **INTERNET Control Message Protocol (ICMP)- RFC-792**
  - **Daytime Protocol- RFC-867**
    - **May 1983**
    - **ASCII string returned with 25 chars [Mon Apr 20 18:11:06 1998\n]**
    - **TCP|UDP Port 13**
  - **Time Protocol- RFC-868**
  - **Network Time Protocol Version 3 (NTP)- RFC-1305**
  - **Simple Network Time Protocol (SNTP)- RFC-1769**

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  - **Daytime Protocol- RFC-867**
  - **Time Protocol- RFC-868**
    - **May 1983**
    - **32-bit unsigned seconds since 00:00 1 Jan 1900 GMT**
    - **TCP|UDP Port 37**
  - **Network Time Protocol Version 3 (NTP)- RFC-1305**
  - **Simple Network Time Protocol (SNTP)- RFC-1769**

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  - **Time Protocol- RFC-868**
  - **Network Time Protocol Version 3 (NTP)- RFC-1305**
    - **March 1992**
    - **32-bit unsigned seconds, 32-bit unsigned fraction of seconds since 00:00 0 Jan 1900 UTC**
    - **TCP|UDP Port 123**
  - **Simple Network Time Protocol (SNTP)- RFC-1769**

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  - **Simple Network Time Protocol (SNTP)- RFC-1769**
    - » **March 1992**
    - » **32-bit unsigned seconds, 32-bit unsigned fraction of seconds since 00:00 0 Jan 1900 UTC**
    - » **TCP|UDP Port 123**

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- **NTP Version 3 Packet**
  - **4 64-bit timestamps**
  - **32-bit seconds**
  - **32-bit fraction of seconds**
  - **Big-Endian layout**
  - **Transported in UDP or TCP**
  - **ERA length approx. 136 years**
  - **EPOCH started 00:00 0 Jan 1900 UTC**

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- **NTP Timestamp Analysis**
  - **32- bit seconds (unsigned)**
    - » **range of 0 to 4294967295 seconds, inclusive**
    - » **136 years, 36 days, 6 hours, 28 minutes, 15 seconds**
  - **Based on UTC which periodically adjusts for leap seconds**
  - **Precise EPOCH date and time is not predictable this far in advance**
  - **Next EPOCH is in 2036**
    - » **February 5th (approx.)**
    - » **Not on a *nice* date and time**
  - **EPOCH handling is in consumers' hands**

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- **NTP Client Computer Software**
  - **No EPOCH support**
  - **What happens in 2036?**

- **UNIX Issues**
  - **Has its own date problem in 2038**
  - **Most NTP servers are UNIX based**

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- **NTP 2000 Issues**
  - **Packet can handle the time (in seconds)**
  - **Primary Time Servers must collect time data from multiple sources and create and NTP packet**
    - » **Source could provide time and date with a bad date**
    - » **Primary server could convert the date and time wrong and create incorrect NTP packets**
  - **NTP is widely distributed across the INTERNET**
    - » **Incorrect time from Primaries could propagate like a virus**

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- **NTP 2036 Issues**
  - **Without both Primary Server and Client software changes the dates are likely to become incorrect**
  - **Currently no EPOCH management mechanisms**
  - **Human intervention is likely on every computer unless sophisticated EPOCH handling is employed**
  - **A vastly greater number of computers will be invloved compared to those with 2000 date issues today**

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- **Conclusions**
  - **NTP packet will likely be fine for 2000**
  - **Some Servers and Clients may have date problems in 2000**
  - **Serious problems will definately happen in 2036 without significant intervention even today**
  - **Additional problems may happen in 2038 on UNIX systems**
  - **Solving both today while fixing 2000 problems will prevent both NTP and UNIX from failing 30 years hence**
  - **Fixing them now will be significantly more cost effective**