NETWORK TIME FOUNDATION

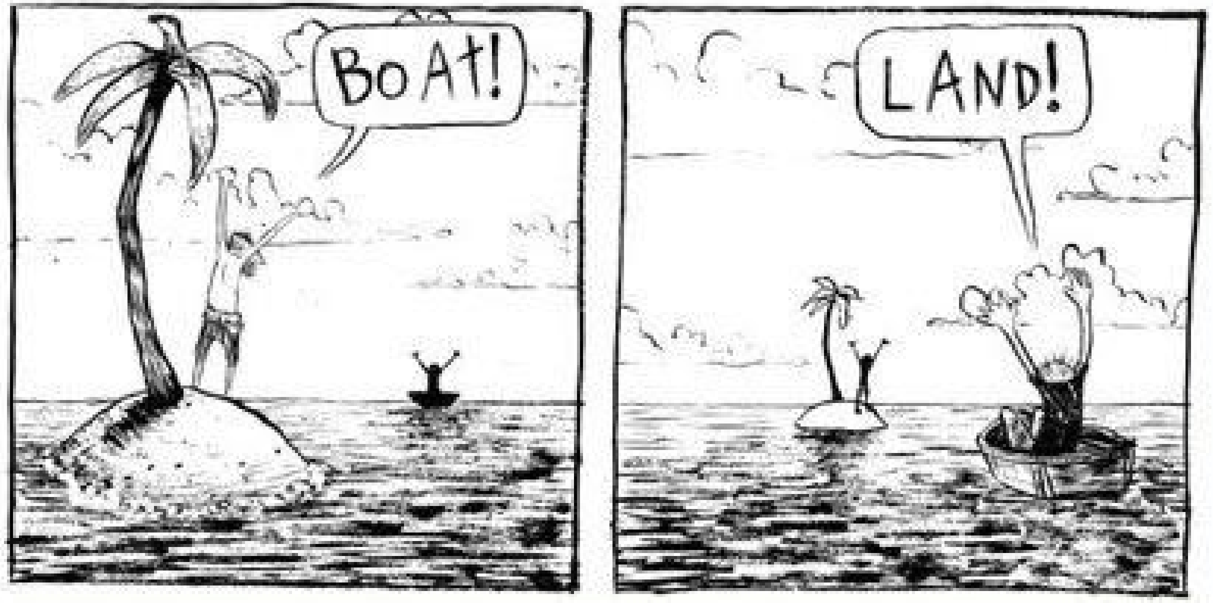
The Future of Time,
January 5, 2014

Network Time and Infrastructure

Who/What is NTF?

- The NTP Project needed the support and backing of a legal entity.
- I felt an “NTP Foundation” would have insufficient scope.
- Network Time Foundation seemed “right”.
- NTF currently supports NTP, PTPd, GPSD, LinuxPTP, RADclock and the General Timestamp API projects.
- NTF's 501(c)3 application has been filed.

Time



Perspective...

Perspective…

- I’m a fan of “robust mechanism” and keeping “mechanism” separate from “policy”.
- I try and remember the Pig and Chicken analogy that the Agile folks use.
- IMO, don’t break in-use stuff. If the in-use thing is good for some and sucks for others, leave the current stuff alone and provide a new alternative.

Remember my favorite between-the-lines Bible quote:

> “Blessed are those who get what they deserve.”

This cuts several ways...

Time

- “Knowing the time” is important because we can note when something happened and we can plan when to do something.
- This requires dissemination of the time, and timestamps that contain “enough” information to be generally useful.
- “Time” means different things to different people.

Time

- It was easier to use “time” when the wobbles were in the noise.
- Timescales solve problems for different groups.
- Problems occur when different groups disagree about “signal” and “noise”.
- Larry McVoy says: In theory, theory and practice are the same. But in practice they are not.

Timestamps

Current timestamps are mostly OK for “local use”. Mostly.

- seconds since some epoch
- <days since epoch>,<seconds since midnight>
- YYYYMMDD-HHMMSS - Long-standing hospital database does not bill millions of dollars each Fall’s daylight-savings correction

Timestamps

- Monotonic time and databases

- System time may be known to be undergoing a correction.
- Error bounds?
- **What timescale is being used?**
- When comparing T_0 and T_1 did anything happen between those events that would affect the comparison? Different timescales?

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Timestamps

- A “clock discontinuity counter” is needed to show where “time steps” have occurred.
- Will a “host ID” be useful when comparing timestamps between multiple systems?
- The NTP 32/32 timestamp format is good for 136 years’ time with a resolution to 233 picoseconds. A 40/32 timestamp is cumbersome but probably sufficient. 64/32 or 64/64 timestamps are convenient and large.

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Timescales

- There are a lot of them.
- Some change never, or rarely (GPS)
- Some change often (IERS-a)
- Local timezones are a sub-case

- Google’s “leap smear”
- Martian Standard Time

Timestamp Structure

- System time
- Amount of pending correction
- Expected/Maximum error
- Timescale
- Clock discontinuity counter
- Host and perhaps Clock ID?
- Structure/API Version number

Leapsecond Timestamp Example

{System Time, Offset to Correct Time}

UTC	NTP-DLM	NTP-Windows	Smear24H
00:00:00.00	{00:00:00.00, 0}	{00:00:00.00, 0}	{00:00:00.00, 0}
06:00:00.00	{06:00:00.00, 0}	{06:00:00.00, 0}	{05:59:59.75, .25}
12:00:00.00	{12:00:00.00, 0}	{12:00:00.00, 0}	{11:59:59.50, .50}
18:00:00.00	{18:00:00.00, 0}	{18:00:00.00, 0}	{17:59:59.25, .75}
23:59:59.00	{23:59:59.00, 0}	{23:59:59.00, 0}	{23:59:58.00, 1}
23:59:59.50	{23:59:59.50, 0}	{23:59:59.50, 0}	{23:59:58.50, .5}
23.59.60.00	{23:59:59.99, .0}	{23:59:59.99, .0}	{23:59:59.00, .0}
23.59.60.50	{23:59:59.99, .5}	{23:59:59.99, .25}	{23:59:59.50, .0}
23.59.60.99	{23:59:59.99, 1}	{23:59:59.99, .50}	{23:59:59.99, .0}
00:00:00.00	{00:00:00.00, 0}	{00:00:00.00, -.50}	{00:00:00.00, 0}
00:00:00.50	{00:00:00.50, 0}	{00:00:00.50, -.25}	{00:00:00.50, 0}
00:00:01.00	{00:00:01.00, 0}	{00:00:01.00, 0}	{00:00:01.00, 0}

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Putting it to Use

A new timestamp structure is only useful if it can be widely and generally portable:

- Kernel support
- Library support
- Application support (NTPv5, etc.)

Adjusting System Time

- Forward:
  - Adjust “system time”, or
  - Increase “amount of pending correction”
- Backward:
  - Decrease “amount of pending correction”

The OS applies pending corrections according to its policy rules.

Adjusting System Time

- Forward time adjustments seem to be pretty straightforward.
- Backward time adjustments are more challenging, as monotonic time is generally “good”.

If we want to step the time backwards, make tiny advances to the system clock when needed and decrease the pending correction by 1 second per second.

Using timestamps

The timestamp library API needs to handle:

- Adding/subtracting timestamps
- Canonicalization of timestamps
- Comparing timestamps
- Converting timestamps (timescales)

Timescale Database

I’m operating on the belief that a timescale database won’t be that much harder to implement and maintain than Arthur David Olson’s Timezone Database.

Ongoing Questions

POSIX mostly decided upon absolute event timers. It would be nice if we could come up with a mechanism to notify a process that the system time had changed so that the application had a way to decide if it wanted to adjust its events or not.

Help NTF Help You

Please visit http://nwtime.org and learn more about Network Time Foundation.

Join NTF and invite others to join, too!

Help NTF help you!