

It's About Time - For a National Resilient Timing Architecture

Presentation by RNTF President Dana A. Goward

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"It's about time." Have you ever noticed that when someone says that they really mean, "It's late. This should have happened long ago"? That has always been my experience.

Time is a funny thing.

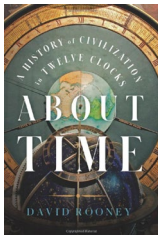
Einstein discovered time is relative. The faster you go, the slower time goes.

I discovered when I was in government that bureaucrats can do Einstein one better. Many can actually make time stand still just by holding a meeting.



The guy who owns Viking Cruise Lines tells us that time is the only scarce commodity, so we better get on one of his boats.

And recently some physicists and philosophers have argued that time doesn't really exist.



In the book "About Time - The History of Civilization in 12 Clocks" David Rooney says that time, or at least measuring time, is a method of control, specifically controlling people.

He tells a story from the year 263 BCE.

The Roman general Manius Valerius Maximus was a returning war hero. One of the things he brought back as a trophy after conquering Sicily was a sundial. He had it mounted on a pillar with his name at the forum and the crowds cheered wildly. Soon there were sundials everywhere.



But soon after that, no one was cheering. The sundials were scheduling people's days and regulating their activity. People were complaining. One playwright wrote:

The gods damn that man who first discovered the hours, and yes, who set up a sundial here, who's smashed the day into bits for poor me. When I was a boy, my stomach was the only sundial, by far the best and truest compared to all of these. It used to warn me to eat... but now I don't eat unless the sun says so. The town is so stuffed with sundials people crawl along shriveled up with hunger.

Another writer called sundials “hateful” and said they should all be destroyed. But it was too late. The efficient Roman Empire had suddenly gotten a lot more efficient.

And that is really the beginning of how and why we find ourselves here.



Regardless of whether time is real or not, timekeeping certainly is. We can reach out and touch clocks. We can see records of events listed by hours, seconds, often nanoseconds.

Timekeeping allows us to understand history – we can place events that have already happened in their proper order. It gives us some control of the future by letting us schedule sequences of events to come. It makes modern life possible.

Over the centuries we have created better and better methods of timekeeping.

Judith Olson at ColdQuanta says her best device can measure down into ten to the minus 18th. That's one quintillionth of a second, or one atto-second. A measurement that she admits, for now, is probably meaningless.

This better and better timekeeping has made us more and more efficient. We split data packets, divide up spectrum, cram more into less.



Timekeeping is a centerpiece of capitalism as we know it. The world's first stock market was established in 1611 in Amsterdam. Its clock was central to operations. From the very beginning trade was constrained to that place and limited to certain times.

This ensured it was efficient, since all the buyers and sellers would be together, and fair because no one would be left out.

Today our financial regulators require milliseconds, network providers need microseconds, and Andy Bach demands nanoseconds.

Soon everyone will likely want more. And the technology will continue to provide. It seems the possibilities are endless and the future bright.

But there are serpents in the garden of our timekeeping Eden. Two of them, actually.

The first is the serpent of over-dependency, complacency, and false trust.

While all of you undoubtedly know the provenance, quality, and assurance of your timing feed, few others do.

For most of the nation, timing comes from a single source, the Global Positioning System. GPS satellites, as you know, are suites of atomic clocks connected to a radios that transmit time signals.

GPS signals and equipment can be easily interfered with and too often are. Frequently this is first detected by errors in GPS-time-based navigation applications.

Most interference is accidental, transient, and localized. But that doesn't mean it is benign.



For example, in 2019 a commercial passenger aircraft was flying in hazy conditions toward what they thought was the Sun Valley, Idaho airport. Because of a spurious interfering signal from somewhere, they were really flying directly toward a mountain towering high above them. Fortunately, a sharp-eyed radar controller hundreds of miles away helped avert tragedy.

For malicious actors, things are pretty easy. Delivery drivers defeat fleet timing and tracking with a \$30 device ordered off the internet. For just a few dollars more, criminals can get a device that will shift time and location to lure those drivers into areas where they can be easily hijacked. The government of Mexico says 85% of all cargo thefts involve a GPS disruption device of some kind.

Compounding all of this, most folks don't even know they are vulnerable. If something goes wrong with our technology – what is the first thing we think? Not that the tech is faulty. We say, “I wonder what I did wrong.”

In 2011, Todd Humphreys showed how manipulating time in an exchange could enable someone to reverse the trade sequence, allowing them to sell something before they bought it, potentially reaping millions. Now, twelve years later, I am confident exchanges and the core financial industry have multiple resilient time sources and sufficient algorithmic protections to prevent that from happening.

Yet 99% of retail financial service customers are outside the New York, Chicago, and San Francisco core financial enclaves. Most likely lack authenticated and resilient time. For them, over-dependency, complacency, and false trust are still real issues.

The second serpent in our timing tech Eden is that resiliency and synch, at the moment, tend to be local (or relative) and costly.

Synchronization has enabled innumerable applications and technologies over the last 30 years. Can you imagine how we could have cell phones without precise time synch?

Yet, in the absence of a sufficiently accurate, resilient, and widely distributed national time scale, that synchronization has tended to be intra-system, rather than to an external common standard.

This adds a layer of complexity and difficulty when systems try to operate nationally and/or with each other.

It also inhibits innovation, makes those without great timing more vulnerable, and limits sales of some equipment and services to the few users and environments which already have authenticated, and resilient timing.

It also means synch is more costly and difficult for innovators and startup entrepreneurs.

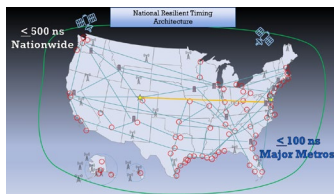


Over 150 years ago the railroads realized they needed a common time reference so they could operate nationwide, efficiently, and avoid conflict. In 1883 they created the U.S.

time zones to synchronize operations across the industry and the nation.

We are approaching a similar moment with technology. Our technology needs to operate nationwide, efficiently, avoid conflict. We need to synchronize operations across industries and the nation. To do this we need to democratize precise timing.

Easily accessed national timing at an acceptable level of precision will be required if America is going to foster innovation and keep finding efficiencies to improve the way we operate.



So... **it's about time** for a Resilient National Timing Architecture.

No surprise, this is something we at the Resilient Navigation and Timing Foundation have supported for quite a while. In fact, we even published a white paper on the topic in October 2020. We followed it up the next year with a second paper on how the government could lead establishment of the architecture easily and inexpensively.

While we urge government leadership, we don't think the government should build anything. There are more than enough companies that can provide timing services more economically, and efficiently than the government ever could.

The government should support the effort with commercial contracts and subscriptions.

Our proposed architecture provides multiple diverse methods of delivering time that could be accessed by as many Americans as possible. It includes fiber connections, suites of existing atomic clocks, at USNO, NIST, national labs and elsewhere, L-band signals from space, and terrestrial broadcast.

It turns out that we weren't the only ones who thought that. Three months after we published our paper, the Department of Transportation released its report on GPS Backup Technologies. They also said the nation needed L-Band from space, fiber, and terrestrial broadcast.

And even though the government agreed with us, I still think we got it right. 😊

Also agreeing with us is a group of CEOs and senior executives from major telecom companies acting as the National Security Telecommunications Advisory Committee or NSTAC.

In their May 2021 report to President Biden, they discussed GPS vulnerabilities and threats, urged establishment of a national timing capability, and funding. They recommended a structure, and I quote:

“...similar to that reflected in the Resilient Navigation and Timing Foundation’s paper entitled “A Resilient National Timing Architecture.” Further, to enhance the ability of commercial entities to afford leveraging this architecture, the Administration should appropriate sufficient funds to lay the foundation for creating this timing architecture, with the Federal Government being the first customer for what will ultimately become a resilient, interconnected network for PNT delivery.”

A very few in government, notably in the Office of Management and Budget, assert that government involvement and leadership is not needed. A resilient national timing architecture will grow organically as a result of free market forces.

This is clearly wrong for a host of reasons.

Among the most important is that there are no commercial incentives to create this kind of fundamental tech infrastructure for broad adoption and use. As the NSTAC mentioned in its report, it is not possible to compete with free GPS.

Even if it were, the kind of broad adoption needed to ensure innovation and national resilience would be stifled by charging fees for basic, utility-level timing.

And even if such an architecture did arise organically as a result of market forces, would it really meet the nation’s needs?

The internet is fundamental tech infrastructure that arose organically, without any guidance or requirements to safeguard public welfare. Are we happy with how the internet turned out? Anonymous trolls, ransomware, elections influenced. Society whipsawed by foreign actors seeking to undermine our values? Yeah, probably not the model we want to follow.

As much as it pains me to say it, some kind of government policy and financial leadership is needed to make a resilient national timing architecture happen. That was recognized by the capitalist CEOs that make up the NSTAC and has been reinforced by industry groups since then.

It's about time for us to establish a resilient national timing architecture.

And we need to do it together in a way that benefits the nation's long-term interests. Fortunately, we have government employees who we pay for just this kind of thing.

Unfortunately, they haven't been tasked to even start this necessary work. It is up to us to insist they are.

I urge all of you to become involved in this discussion through ATIS, your own government relations departments, as expert and informed individual citizens, and/or as members of the RNT Foundation. If you are interested in doing so, RNTF member or not, please contact us. We are eager to support your efforts.



As an example of a near term opportunity for you to tell the government what you think, [NTIA is asking for comments on how it should spend \\$1.5B to further deployment of 5G and secure its supply chain.](#)

We think establishing a resilient national timing architecture, which could probably be done for less than \$100M, would support all seven activity and goal areas listed in the announcement.



We are happy to share [the comments we have submitted to NTIA](#) if they will help you frame your thoughts and comments.

As Americans we are privileged and benefit immensely from living in an open, democratic society. At the same time, we all have a duty as citizens to protect that society and foster the common good.

Everyone in this room has an impressive resume. You each are expert in your fields. You each have specialized knowledge and understanding of things about which most policy makers don't have a clue. You have a duty as a citizen to share your knowledge with leaders and help assure the nation's future.

Let our government leaders know - it's about time to establish a powerful tech heartbeat for America. A resilient national timing architecture.

It is always a privilege to visit and speak with this august group. Thanks for having me back again.