

## Contrapuntal Network Topology

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## Abstract

Traditional models of network topology have served us well. Whether these models described water ways used by agrarian civilizations or modern geospatial satellite networks. In this emerging age of distributed networks and martian rovers, the current technology is approaching its limits in our useful paradigms. This essay aims to propose new ways of thinking as the need for interplanetary networking and data sharing comes more into view. The need for long distance data integrity and time keeping will be at the core of problems faced by technologists as we reach for the stars. What will this topology look like and how will we trust digital data as it traverses larger and larger distances? How will computer nodes maintain a consensus of meaning of the data that is collected and transmitted?

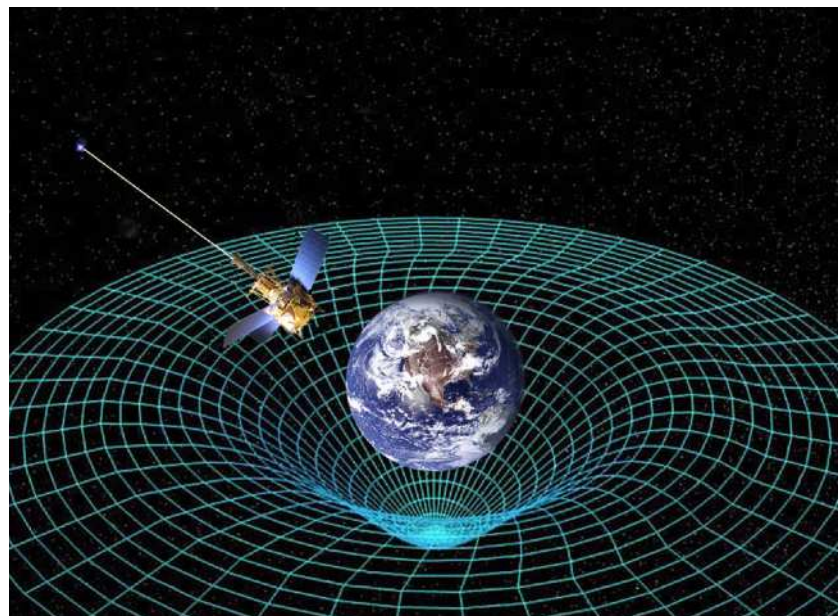
Our Earth bound networks are able to use an old heliocentric time keeping model that will not suffice for off planet systems (because they simply do not revolve around our sun). What will an interplanetary “timestamp” look like? How will we interpret these values a million miles away? 100 million miles away?

As we deploy artificially intelligent computer systems, will these entities view the networks we build for them as “social networks”? Will we build systems that “procreate” to overcome the need for maintenance over long periods of time and distance?

Keywords: bitcoin, network topology, network consensus, network time keeping, artificial intelligence, lojban

A catch phrase of the day is “decentralized blockchain technology”. With the wider adoption of BitCoin and “crypto currency” the term blockchain can be heard everywhere. But what of the underlying technology of blockchain? Generally speaking the computer science problem solved by BitCoin technology is that of computer systems sharing a ledger that is trusted to have a high degree of integrity through cryptographic means outside the scope of this paper. It is generally accepted that the long term implications of this technology are hard to imagine, even for the huge array of software developers working on these ideas. I am willing to take a leap and say that interplanetary data integrity is a big idea that will eventually be tackled by this “decentralized ledger” technology.

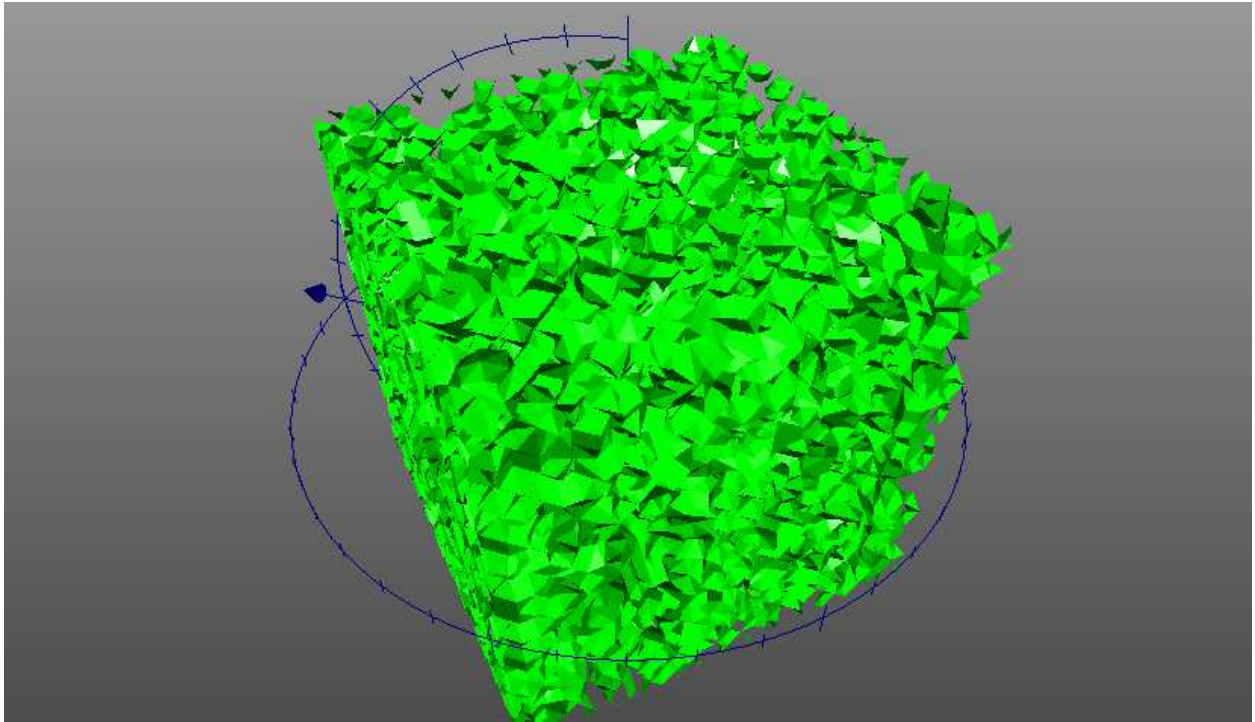
It is generally accepted that “time” gets distorted at very large distances (Redd 2017). As we deploy systems for exploration, and as these systems gather tremendous amounts of information.



How will we know that the data collected is correct? I propose that we start deploying these systems as a decentralize network of nodes that work in concert, just as nodes in a Bitcoin type network work here on Earth. This network of deployed nodes would work to copy, retransmit and verify data transmitted from nodes further from Earth.

## Time Keeping at Large Distances

$r^2 = x^2 + y^2 + z^2$  is a familiar fractal formula.

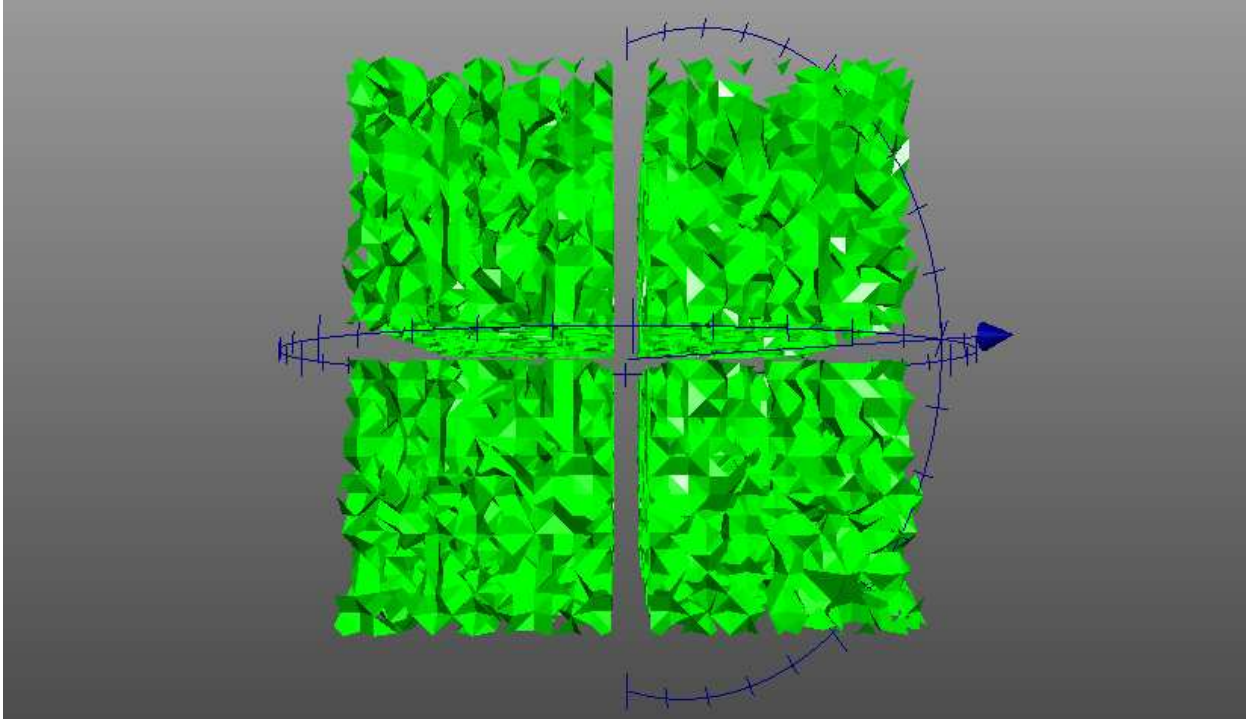


A fractal time unit as simultaneously fungible and scaleable. Self similar at large and small distances as a basis of an interplanetary timestamp unit.

We currently relate the term “fungible” with commodities and monetary units. When dealing with warped time over long distances the current time units fail. The need for a divisible yet self similar time unit will become imperative for computer networks to synchronize over long distances. I propose this time unit be named “te’a” (Hagiwara, Masato, 2017) borrowed from the logical language “Lojban”.

This theoretical timestamp will both encapsulate time and location into one value.

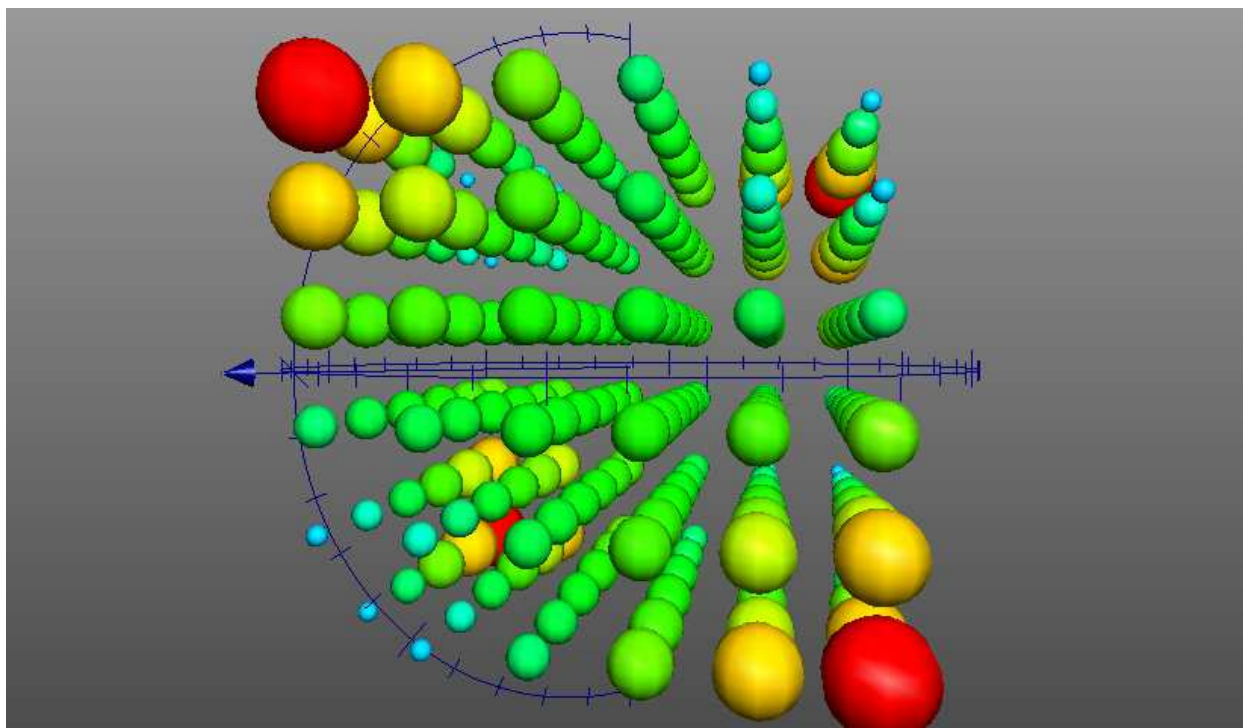
$$p = r \cdot \frac{\left( \pi xyz + \frac{\pi}{xyz} \right)}{\left( \pi xyz + \frac{\pi}{xyz} \right)} \quad p^2 = x^2 + y^2 + z^2$$



### Distance Trust Formula

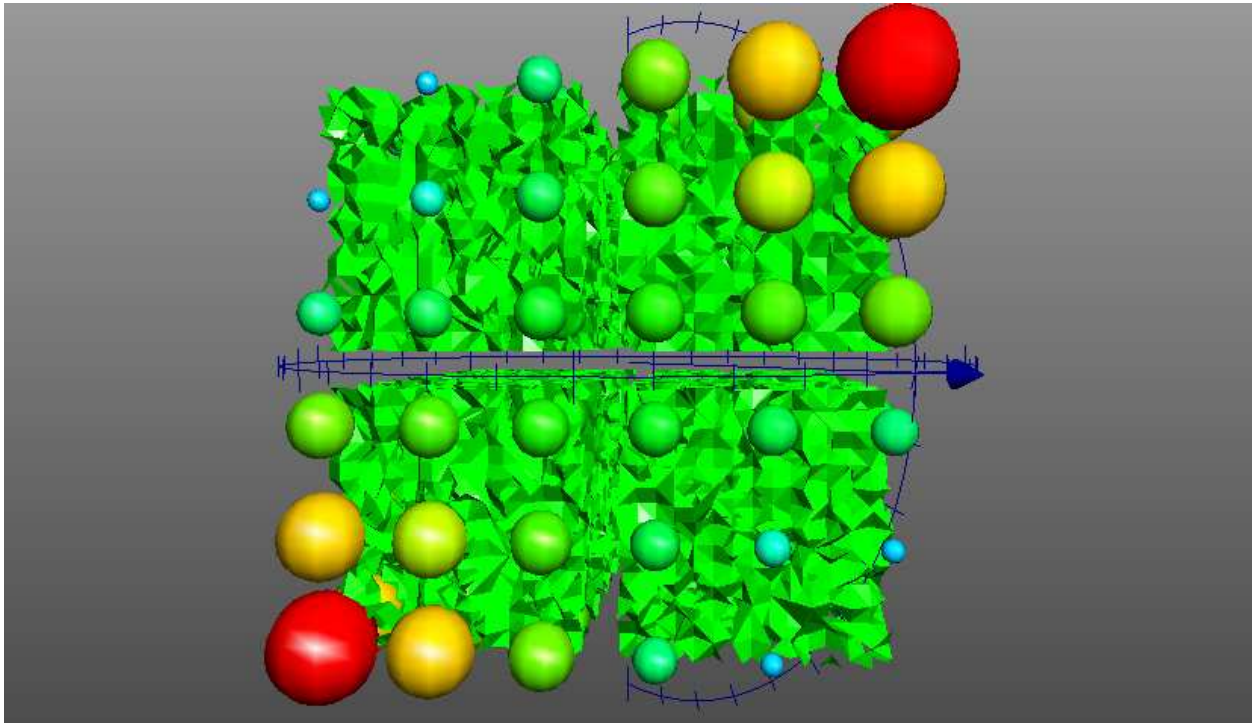
At larger and larger scales, data integrity becomes a huge problem. The need for scalable networks is critical. This need is not limited to terrestrial implementations. How should we trust nodes in an interplanetary network? How do we know that the data from these nodes has not become corrupted while in transit? We can hardly travel 100 miles without dropping a (digital over radio) cellular phone signal. The limit of this data transmission approaches zero as distance increases.

Trust = 
$$\pi xyz + \frac{\pi}{xyz}$$



The level of trust can be distributed along a gradient based on distance. To put it simply, the closer the node the more it is trusted. The equation above (or a future variation) should allow a network to tend toward equilibrium of trust in a network. I humbly admit much more research needs to be completed to support this claim but contemporary developments are already solving this problem on an Earth bound network ([bitcoin.com](https://bitcoin.com), 2017).

## Contrapuntal Network Topology



Time and place are embodied in the proposed formulas and structure proposed in a Contrapuntal Network Topology.

The integration of time and place into a unique value merged with the data collected/transmitted by a node statistically ensures a crypto-logically adherent entry into the proposed interplanetary blockchain (Sean, 2016). There are many emerging technologies to ensure integrity of this proposed system including IPFS (Benet, 2015).

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\*my word processor will not indent citations correctly.