SPACEX STARLINK SOLUTIONS

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Contents

Abstract. This is an outline of possible solutions and novel approaches towards SpaceX's Starlink, a network of satellites.

1. Introduction

A casual conversation with Anthony Rose (SpaceX) about the challenges facing SpaceX's Starlink prompted further private discussions amongst the two authors about possible solutions and novel approaches.

Part 1. Qualitative Summary

1. Watchdog Timer.

Part 2. Outline of Solutions

2. Watchdog Timer

Let $i = 0, 1, \dots N_{\text{WD}} - 1$, where N_{WD} = total number of Starlink satellites with a Watchdog (WD) timer.

Let $t_{0,i} \equiv t_{0i}$ be the time each Watchdog Timer i gets initialized. This is when the internal watchdog timer begins counting.

Suppose the time duration for a WD timer to "expire" or "timeout" (i.e. once t_{WD} time elapses, the WD rests to either indicate something went wrong, or on purpose) is chosen to be same $\forall\, i = 0, 1, \dots N_{\text{WD}} - 1$.

either / or

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Because it's not safety critical, but mission assurance.

Let T_{WD}

3. Network Map

"Ping loops"

One could begin by thinking of the network of Starlink satellites in terms of *graph theory*: the vertices V would be each of the satellites, possibly including the ground station(s), and edges E are the "connections" or "pipes" between each of the satellites.

However, we would posit that this is not enough; the satellites are in "real", *physical* space. Being that comes all the nuances of physical space, including "pseudo-locality" (some satellites are closer to each other than another group of satellites; this isn't captured in graph theory).

Thus, we would posit that this is also an *embedding* problem in Euclidean space $\mathbb{R}^3$. The way to tackle this is with *topological graph theory*.

4. Predict the next n_k frames and send them

The goal is to predict the packet that should've been received.

4.1. Send a Checksum after N_p packets.

To ensure data integrity, we can send a *checksum* after each N_p packets. This checksum can be decoded with *polynomials*. This is also an opportunity to leverage concepts from *algebraic geometry*. In algebraic geometry, in a qualitative sense, the "eigenvectors" of a polynomial can be found, and this "basis" can be used to help decode the checksum with a minimum or small overhead (for machinery).

5. Open LST

We would broadcast in UHF.

6. Orbital Parameters

We would broadcast an *error code*. This error code would include a NIDI and a timestamp.

References

[1] **Watchdog timer circuit**. Datasheet - production data. STMicroelectronics